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By-Zancanella, James, Comp.; Lein, Charles D., Comp.

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Attended by five school administrators and 13 vocational teachers from the state of Wyoming, a 2-week workshop was held in the summer of 1967 on the campus of the University of Wyoming in an effort to better meet the vocational needs of youth. The featured presentations in this seminar were: (1) Progress and Needs in Vocational Guidance, (2) The Framework and Concept of the Wyoming Research Coordinating Unit for Vocational-Technical Education, (3) Basic Research Methods in Vocational Education, (4) Basic Aspects of Research, (5) Program Evaluation and Review Techniques for Educational Research Project Development and Control, (6) Vocational Education Research and Goals in Utah, (7) Research at the Local Level to Solve Problems in Vocational Education, (8) Research, Developmental-Pilot, and Training Projects in the Field of Vocational Home Economics Education, (9) A Case for Agricultural Education in the Public Schools, (10) New Developments and Their Impacts on Trade and Industrial Education, (11) The Future of Computers in Education, (12) 3R+R=Innovation, (13) Communication Technologies, (14) The Technology for Children Project, and (15) Programed Instruction. A listing of Wyoming's industry by county for 1967 is included. Each seminar participant was required to develop a proposal for an individual research project to be conducted during the 1967-1968 school year. (DM)

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RESEARCH SEMINAR
IN
VOCATIONAL EDUCATION

COLLEGE OF EDUCATION
UNIVERSITY OF WYOMING
SUMMER 1967

VT007194

SELECTED PROCEEDINGS AND INFORMATION FROM THE 1967 SUMMER WORKSHOP IN RESEARCH IN VOCATIONAL-TECHNICAL EDUCATION.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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Compiled and Edited
2 by Comp.
James Zancanella, Head 1
2 Comp and
Charles D. Lein, Graduate Assistant
Department of Vocational and Business Education

College of Education
University of Wyoming Univ., Laramie. Coll. of Education.
3

Sponsored by

3* Wyoming State Department of Education, Cheyenne.
Harry Roberts, Superintendent

4* Wyoming Research Coordinating Unit in Vocational-Technical Education, Cheyenne
Bruce C. Perryman, Director

1967

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PREFACE

In an attempt to better meet the vocational needs of the youth of Wyoming, a two-week workshop in research in Vocational-Technical Education was designed and conducted during the Summer of 1967. The program was co-sponsored by the University of Wyoming and the Wyoming Research Coordinating Unit, Vocational Education Division, Wyoming State Department of Education.

The participants in the workshop were selected by the co-directors, Dr. James Zancanella, Chairman, Department of Vocational and Business Education, University of Wyoming; and Bruce C. Perryman, Director, Wyoming Research Coordinating Unit. All of the participants were involved in public education in the State of Wyoming, with five of the participants being school administrators and the remaining thirteen coming from the areas of Business and Office Education, Distributive Education, Home Economics Education, Vocational Agriculture, Industrial Arts, and Guidance.

The program featured speakers and presentations outlining the steps and procedures of developing research proposals and projects, and demonstrations of the latest techniques and tools available to the modern researcher in education.

Following the introductory presentation by Dr. James Zancanella entitled, "An Introduction to Vocational Education," Dr. Benjamin Novak, Vice-Principal, Frankford High School, Philadelphia, Pennsylvania, discussed the role of vocational guidance and how it is related to vocational education. Mr. Bruce C. Perryman outlined the framework and concept of the Wyoming Research Coordinating Unit, with special emphasis being devoted to the procedures and techniques of writing research proposals, the funding of research projects, and the assignment of proposal problems.

A panel discussion centering around the topic, "Identification and Importance of Vocational Education Research in Wyoming," featured eight prominent educators from the State of Wyoming. The panel members included Dr. James Zancanella and Mr. Bruce C. Perryman; Dr. Glenn Jensen, Head, Adult Education and Community Services Department, College of Education, University of Wyoming; Mr. Charles Kline, Director, Vocational-Technical Education Division, Wyoming State Department of Education; Mr. James Durkee, Teacher Educator, Agricultural Education, College of Education, University of Wyoming; Mr. Rod Bolender, Director of Guidance, Wyoming State Department of Education, and Mrs. Myrtle Gillespie, Director, Home Economics Education, Wyoming State Department of Education.

Dr. Robert F. Noble and Dr. James R. Beck of the University of Wyoming took micro and macro approaches, respectively, to the exploration of basic research methods and design. Their presentations were followed by a discussion of PERT (Program Evaluation Review Techniques) by Mr. William H. Nightwine, Assistant Director, Wyoming Research Coordinating Unit, Wyoming State Department of Education.

Mr. John F. Stephens, Director, Utah Research Coordinating Unit, Utah State Department of Education, discussed vocational education research and goals in Utah. The Director of the New Mexico Research Coordinating Unit, Mr. Gene Schrader, gave some insight for the conduct of research activity in small schools. The presentations and discussions concerning the research activities in Utah and New Mexico provided additional ideas as to what was being done in states which are geographically and economically similar to Wyoming.

Mr. Bob Wear, Educational Representative, Meter-Master Instrument Corporation, Denver, Colorado, discussed computer applications in education and in research, with special emphasis directed toward the applicability of the Bi-Tran Six Computer to such situations.

The most mechanically complex presentation was entitled "Communication Technologies," and was sponsored by the Mountain States Telephone Company. The Bell Telephone Telelecture system was used to bring a speech by Dr. V. A. Ryan live from Corvallis, Oregon. Dr. Ryan, Director of the Oregon Research Coordinating Unit, spoke on the topic, "Needed Research in Vocational-Technical Education." The presentation was followed with a question and answer period between Dr. Ryan and the participants in the workshop.

Similar procedures were used in a presentation by Elizabeth E. Hunt, Director, Technology for Children Project, State Department of Education, Trenton, New Jersey. The New Jersey Technology for Children Project was discussed by Mrs. Hunt via Telelecture and was followed by a question and answer period.

A representative of Victor Electrowriter, Chicago, Illinois, demonstrated the uses and applicability of a Telelecture-Telewriter, and Mountain States Telephone Company personnel demonstrated how the telephone can be used to supplement the planned curriculum of almost any school. Through the Dial Retrieval System, a French lesson was retrieved from the University of Illinois. To further demonstrate the system, excerpts of the inaugural addresses of John F. Kennedy and Harry S. Truman were retrieved from the Educational Service Center in New York City. Retrieval was also made of up-to-the-minute happenings on various bills which were before Congress. The Congressional information was retrieved from the "Washington Dial," and was sponsored by the United States Chamber of Commerce, Washington, D. C.

Representatives from the Bell System utilized the Teletypewriter in demonstrating their Information Retrieval System. Retrieval was made of research material, and live problem-solving was accomplished through the coordinated and combined application of a computer at Cooperstown, New York, with the Teletypewriter located in a classroom at the University of Wyoming.

A follow-up on the "Communications Technologies" program was presented by Mr. D. V. Koza, District Manager, Behavioral Research Laboratories, Englewood, Colorado. Mr. Koza discussed "The Concept of Programmed Instruction," and the "Concept of Programmed Remedial Reading." His presentation was followed with a Telelecture on programmed instruction and remedial reading.

The participants in the workshop spent most of their out-of-class time reading supplementary materials and preparing individual research project proposals. These proposals were submitted to the Wyoming Research Coordinating Unit at the end of the workshop. Several of the projects were funded and were carried out in their entirety during the 1967-68 school year.

The evaluations at the end of the workshop indicated that the Wyoming Research Coordinating Unit and the University of Wyoming were successful in accomplishing the intended purpose of the workshop. A selected group of Wyoming educators were oriented to the need, techniques, procedures, and applicability of research in the various areas of vocational education, with special emphasis being directed toward research on the local level. The orientation to research was supplemented with constant participation and student-involvement, in both the formal workshop sessions and in the participants' design of actual research proposals.

Although the long range results of the workshop will be difficult to measure, the evolutionary process of exploratory progress in vocational education in Wyoming, and in the United States as a whole, will ultimately enhance the quality of vocational programs throughout the country. Such changes will encourage the development of an improved final product from the educative process--better prepared graduates who can make significant contributions to society.

PROGRESS AND NEEDS IN VOCATIONAL GUIDANCE*

Dr. Benjamin J. Novak
Vice-Principal
Frankford High School
Philadelphia, Pennsylvania

Although the guidance movement largely owes its being to vocational education, it is not at all certain that the parent has kept pace with its offspring. Thus, in this current wave of collegiate-academic aspiration, it appears that vocational educators are guilty of several oversights: (1) lack of awareness of current developments in vocational guidance; (2) inadequate practice of vocational guidance in relation to vocational programs; and (3) failure to persuade the American public of the values and needs of vocational education.

Vocational educators led in the establishment of the National Vocational Guidance Association. In 1952 the association changed its name to the American Personnel and Guidance Association (APGA).

For a long time many states had only such guidance services and personnel as were maintained by the division of vocational education. The George-Barden Act of 1946 helped to strengthen guidance programs, supervision, counselor training, testing, and surveys.

Despite these impressive contributions, vocational educators must not overlook other recent advances in vocational guidance.

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*Reprinted from "Industrial Arts and Vocational Education," January, 1968. An article by Dr. Novak, which was based on his personal presentations to the workshop at the University of Wyoming.

Developments in Vocational Guidance

Current findings worthy of note include:

1. Expanded Standard Testing--The Defense Education Act of 1958 has broadened the use of standard tests throughout the 50 states. Measures of mechanical and other special aptitudes have made relatively little progress, however.

2. Psychological and Sociological Aspects of Work--Recent findings show that vocational guidance and job choice are not the simple, mechanistic processes that some people think. Psychologists Donald Super and Eli Ginsberg of Columbia University, and Anne Roe of Harvard, have shown that many changing individual dynamics affect choices and adjustment. Sociologists are showing that parents' occupations, socio-economic level, and other influences are important in determining careers.

3. Manpower and Employment Trends--The United States Department of Labor now is able to project trends reliably into the future. Looking ahead to 1975, the per cent of persons employed in technical, clerical, and service fields will increase. The proportion of craftsmen and foremen will remain essentially constant, and the semi-skilled will fall off slightly. Although farm workers continue to decline in numbers, their training must be increasingly sophisticated.

4. Women in Employment--Our labor force of 79,000,000 is made up of one-third women. Employed married women now outnumber the single. Women are increasingly stable in employment, many interrupting careers for only a few years while their children are very young. American women, in contrast with females in many foreign countries, choose careers from a restricted range of stereotypes.

5. Population Mobility--More than twenty per cent of the population changes residence during the course of a year. Cities and suburbs are changing rapidly, suggesting the need for continuing reappraisal, and revised vocational planning on national, regional, state, and local levels.

6. Technological Change--Vocational educators know well the fact of technological change. In its wake come changing conditions of employment and new careers for many people. The revised third edition of the Dictionary of Occupational Titles (DOT) (1965-1966, U. S. Department of Labor) is an important three-volume publication describing 22,000 occupations, along with interpretive material. It is worth careful scrutiny by the vocational educator.

7. Changing Status of Minority Groups--Legislation and social progress make it increasingly important that all minorities be prepared to the limits of their potential and interests. Vocational educators should no longer be restricted by apprehensions that Negroes, Indians, Mexicans, and other Latin Americans, and persons of every ethnic, religious, and language group shall be denied entry into the full range of career opportunity.

8. "Money at Last"--Money has been a deterrent to the adequate development of many vocational programs. Recent federal legislation (National Defense Education Act of 1958, Manpower Development Training Act of 1962, Vocational Act of 1963, and the Elementary and Secondary Education Act of 1965), at last provides funds on a large scale. For successful implementation, hard work is needed.

What are Some Needs?

Vocational educators have been painfully aware of certain long-standing difficulties with the vocational program that arise from inadequate understanding and practice of vocational guidance. Many of these suspected shortcomings have been confirmed by a recent survey.*

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*"The Role of the Secondary Schools in the Preparation of Youth for Employment," by Kaufman, Jacob; Schaefer, Carl J.; Lewis, Morgan V.; Stevens, David W.; and House, Elaine W., Institute for Research in Human Resources, The Pennsylvania State University, University Park, Pennsylvania, February, 1967.

In this project, nine cities were studied by a team of educators including vocational specialists, guidance experts, and representatives from labor and management.

The study had four major aspects:

1. Schools were visited in which classes were observed, and teachers, administrators, and students interviewed. Teachers were asked to fill out questionnaires to assess their attitudes toward both vocational and college preparatory education. A total of 25 schools was studied and 1,600 questionnaires were obtained.

2. Employers and union officials were interviewed and given questionnaires to complete and return by mail.

3. On-the-job supervisors of graduates completed a rating scale on the preparation and performance of the graduates.

4. Vocational, general, and academic graduates who entered the labor force directly on graduation were interviewed.

Among pertinent findings drawn from the survey are:

1. Enrollments in vocational education are low in relation to the occupational distributions in the community.

2. School participation in placing vocational graduates in jobs is low. Less than one-third of the trade and industrial graduates obtained jobs directly related to their training.

3. Of the vocational graduates, about one-half recalled discussing their course choices with their counselor, and one-fifth discussed their job plans. The figures for the academic graduates were three-fourths and one-third, respectively.

4. No pattern of superiority was established for separate vocational high school, versus a vocational department in a comprehensive high school. Vocational graduates of comprehensive high schools felt more "looked down on" by pupils in other curricula than did graduates from separate schools. Negative attitudes toward vocational education were detected among academic teachers. These failings were especially strong in the comprehensive high schools.

5. Many employers were pessimistic about vocational education, and some union officials in the skilled trades were reluctant to give credit for school preparation. Coincidentally, advisory committees were found to be generally weak and limited in use.

6. Male Negro graduates, in larger numbers than other groups, reported being advised by school officials to take the general curriculum rather than entering training for skilled trades. School officials pointed out that Negroes could not be placed in apprenticeships.

7. Vocational offerings for girls were found to be limited in scope. Girls, presumably because of both the restricted options and the occupational stereotypes for women characterizing our American culture, indicated a choosing of high school courses, less out of interest, than merely to prepare for a job.

8. Placement and follow-up services generally were weak.

9. The average school-counselor ratio was 440-1.

What Can We Do?

These findings underscore some needs and problems of long standing and focus upon newer developments which, until now, have had too little implementation in the vocational program.

It must be presupposed that the superintendent and the director of vocational education have a thorough knowledge of vocational education and its needs and that they exercise vigorous joint leadership in moving vocational programs forward.

The following steps can be recommended:

Publicity: The story of vocational education needs continual intelligent, vigorous, and dramatic retelling. The general public, boards of education, parents, and teachers at the elementary and pre-vocational levels must be kept informed, literally day-by-day, and given opportunity to learn first-hand about the vocational programs.

This includes the classroom teachers in the comprehensive secondary schools and the vocational schools themselves. In this era of near hysteria over collegiate education, it will never be possible to offset all of the various unrealistic forces, but broader knowledge and information can set each in better perspective.

Devices include regular (preferably weekly) press releases, talks to parents and service clubs, colorful brochures, visits to see the program in operation, recognition of successful industrial leaders, including alumni, a fostering of alumni loyalties, display of products and skills, and participation of vocational students in school activities on an equal basis with students from all other curriculums.

There can be no substitute for a sound vocational program; but no program, whatever its quality, can succeed without the proper enlightenment of the public. The academic teachers, in particular, must be shown, first-hand, what vocational education is able to achieve. This takes a modicum of missionary zeal.

Upgrade the Counseling Service: Many counselors probably devote more time with, and are more comfortable in aiding the academically oriented in career and educational planning. There are many reasons for this. Pressures are greater for college orientation and placement, academic pupils often are more articulate and confident in seeking aid, and many counselors are burdened with overloads far above the recommended 250 pupils per counselor ratio. A sensible counseling load is obvious, and such a goal must be pressed by all.

The remedies, however, are not so simple. Vocational programs tend to be complex and varied; they are foreign to the often academically oriented counselors. It is necessary, therefore, that the counselors be: (1) properly prepared, (2) suitably informed, and (3) self-propelling in learning for themselves, if the complete spectrum of guidance for all pupils is to approach realization.

The counselor needs balanced, practical courses in vocational education, occupations, and testing. Industrial summer work experience is a phase of counselor preparation that too often is overlooked. The general administration and vocational director must be responsible for meeting regularly with the counselors and explaining thoroughly to them the purposes and content of the vocational program. Tours of the facilities should be arranged at regular intervals, and meetings held with the shop teachers. Written materials need to be provided and explained.

Formal in-service programs can be set up to insure motivation and further coverage. The vocational shop teacher himself must be informed on careers growing out of his specialty, include occupational opportunities in his teaching, have a specialized career file in his shop, and share his knowledge with the counselor. In-service instruction for the shop teacher in vocational guidance likewise is highly desirable.

Similar procedures should be followed, with equal vigor, with the counseling staff of the schools feeding pupils into the vocational program, including, by all means, the elementary counselors. They also should be brought in to observe the problem in action and share thinking with the vocational staff and the upper secondary school counselors.

Often, little is said about the guidance services in the specialized vocational school itself. Here the counselor needs to make the same effort in providing a balanced service as does the counselor in the comprehensive high school. Pupils have the same needs, even to admitting an incorrect choice and moving into another educational program.

No counselor is worthy of the name if he fails to study his job and to set up formal and self-directed tasks that will enable him constantly to broaden his comprehension and efficiency.

Broaden the Program: An enlightened public, administration, and counseling staff will actively support a broadened program of vocational education that addresses itself to enlarged vocational offerings--together with an imaginative guidance program, for girls, reactivates advisory committees on a vigorous footing, and helps the minority groups, handicapped, and other disadvantaged to fullest development.

For too long the self image of vocational education has been an "aristocracy" embracing largely the skilled occupations, expanded more recently to include technical and semi-professional careers. The growing demand for service personnel poses a need for new training services under the leadership of vocational educators. Short-term and cooperative training programs for the semi-skilled and other types of specialized job training also need amplification.

Programs for girls need study and expansion. Persons of all minority groups should be encouraged to master any learning and skill that is in keeping with their interests and potential. A place must, and will, be found for them in employment.

Conduct Research: Vocational education shares the neglect of research that characterizes most phases of education. Aside from formal, sophisticated projects, much modest, yet useful, investigation can be pursued. It can begin with such seemingly unimpressive matters as good records and an historical file. The passing of even a few years leaves many schools and programs lacking in reliable data, save in uncertain memories. Surveys, follow-up studies on a simple scale, data in admission and retention, all can lead to more sophisticated treatment. Research of any sort is impossible with confused data. Keep good data, then work out ways to use what you have.

Make Long Range Plans: A very common failing of educators, shared fully in the vocational and guidance fields, is lack of imagination and foresight in projecting immediate and more remote needs. Under current federal and other financial grants, educators hasten to spend money that is suddenly available. This tends to produce at least some inefficiency and oversights.

How helpful would it be if the administrator, vocational director, and guidance staff long since outlined and budgeted the time, money, personnel, facilities, and equipment that are needed to insure a good program! How helpful if they were to establish priorities, then proceed to fight jointly for their implementation! Such an approach is desirable, even if something else must, perforce, be sacrificed.

Many impressive developments are appearing in the educational scene, including vocational guidance. Every vocational educator should inform himself in this area, and then implement what is best in vocational guidance for all pupils, not overlooking those who need and desire to pursue the sometimes less obvious routes of vocational education.

THE FRAMEWORK AND CONCEPT
OF THE WYOMING RESEARCH COORDINATING UNIT
FOR VOCATIONAL-TECHNICAL EDUCATION

Bruce C. Perryman
Director, Wyoming Research Coordinating Unit
State of Wyoming
Department of Education

I. Introduction: Research, Training, Experimental, Developmental, and Pilot Programs

A special provision of the Vocational Education Act of 1963 emphasizes research and experimentation to improve and strengthen the vocational education program throughout the United States. This provision reserves 10 percent of the basic appropriation for grants each year to pay part of the cost of research, training, experimental, developmental, or pilot programs which are designed to meet the special vocational education needs of youth, particularly those with academic, socioeconomic, or other handicaps.

These grants are awarded by the U. S. Commissioner of Education directly to colleges and universities, other public or nonprofit agencies and institutions, State Boards of Vocational Education, or to local educational agencies with approval of the State Board. While the State Board's approval is not required for a grant to a college or university, the USOE recommends that the proposal be developed with the knowledge of an appropriate Board Official.

A total of $17.75 million was authorized for these grants in Fiscal 1966 and $22.5 million for each year thereafter; however, due to the Viet Nam war and other federal projects, an apparent lesser degree of emphasis has been given to research for Vocational Education.

In administering the research, training, and experimental programs the USOE is concerned with three general subject areas:

1. The identification of current and future employment opportunities and the skills needed to hold the available jobs.

2. The development of human resources, including studies of the characteristics of vocational students and the implications of this information for vocational education programs.

3. The development of educational resources and training programs, including improvements in vocational curricula and vocational guidance and counseling.

The USOE staff offers consultation in the preparation of research proposals, particularly to institutions, school districts, and community colleges which are not experienced in the planning and writing of research applications.

The USOE, through its Division of Adult and Vocational Research, also offers assistance in expanding state and regional capabilities for research and development in occupational education. Several research centers are planned to administer projects, develop materials, train teachers and serve as clearing-houses of information. The first such center was established at Ohio State University under a $610,130 Federal grant.

Federal grants for research, training, experimental, developmental, or pilot programs cover the major part of the cost of the project. The applicant institution or agency is expected to contribute some funds or services to the over-all cost. No fixed percentage or amount is set, but the average rate of contribution has been 20 per cent.

Application Procedure: Applications for research, training, experimental, developmental, or pilot grants are submitted to:

Bureau of Research
Division of Adult and Vocational Research
Office of Education
Department of Health, Education, and Welfare
Washington, D. C. 20202

There are four deadlines per year for applications: September 1, December 1, March 1, and June 1. Applications must be prepared in accordance with instructions and a format contained in a pamphlet published by the Division of Adult and Vocational Research, entitled "Conditions and Procedures: Grants for Research, Training, Experimental, Developmental, or Pilot Programs in Vocational and Technical Education." Twenty copies of the application are required.

An application must describe the project and its objectives, list principal investigators and personnel involved, and include a budget. The budget may cover salaries and wages, costs of materials and supplies, rental of special equipment, travel, and costs of publishing results of the project. An allowance for indirect costs, to cover overhead expenses, is limited to 20 per cent of the total direct costs.

Each institution or agency receiving a grant is expected to provide the Division of Adult and Vocational Research with 225 copies of its final report on the project and 25 copies of an abstract of the report.

Evaluation Criteria: Applications for grants are reviewed by the Division of Adult and Vocational Research and various review panels. All proposals are evaluated according to their educational significance, the plan for the program, the experience of key personnel, the adequacy of facilities, and the economic efficiency of the proposal.

With proposals for experimental, developmental, or pilot programs, special consideration is given to programs involving youths in economically depressed communities who have academic, socio-economic, or other handicaps which prevent them from succeeding in regular vocational education programs. Another factor is the experimental or innovative aspect of the proposal.

II. The Wyoming Research Coordinating Unit for Vocational-Technical Education

Sometimes it is not possible to institute as part of the regular vocational education program, the special services, and educational aids designed to benefit the economically, the academically, and the socio-economically handicapped, because sufficient funds are not available or because other educators or other community agencies require more proof of the necessity for, or probable success of, such programs before they will extend the necessary cooperation.

The answer to this problem quite likely may lie in developmental, experimental, or pilot research programs.

Equally important is the basic fact that the regular vocational education program, without proper and valid discovery of its necessity, is merely a rationalization for existence. Ongoing research, research proposals, and proposals for developmental, experimental, and pilot programs which deal with the vocationally oriented should be coordinated within the State. There is a need for coordination between those doing research and those who need the new knowledge to improve programs.

The Vocational-Technical Education Research Coordinating Unit (RCU) was approved for the State of Wyoming effective June, 1966. The Unit was funded under provisions of Section 4c of the Vocational Education Act of 1963, and is located in the State Department of Public Instruction. The Unit is responsible to the State Director for Vocational-Technical Education, Mr. Charles A. Kline.

As a service-oriented arm of the Vocational-Technical Education Division, the Research Coordinating Unit provides leadership in stimulating research and development activities within the State. In view of its coordinative capacity, the Unit works closely on multilateral basis with the University of Wyoming, community and junior colleges, area vocational-technical schools, local school districts, governmental agencies, business and industry, labor, and all other entities interested in vocational-technical education research. Through interaction of research with these agencies, the Research Coordinating Unit gains vocational-technical information which has proven valuable and applicable to the improvement and the development of new programs for the State of Wyoming.

Purpose of the RCU

It is the intent of the Wyoming Research Coordinating Unit to relate all state-wide vocational-technical education research activities in such a manner that isolated and uncoordinated research programs and activities will become more unified, thereby benefiting all students and professionals engaged in vocational education. The RCU is not intended to be a research agency.

Specifically, the Research Coordinating Unit follows the broad objectives set forth in the First National Meeting of Directors of RCU in Washington, D. C., in July, 1965:

1. Establishment of an atmosphere in Wyoming that commits itself to research and is receptive to it--especially with State staff, school leaders, legislators;
2. Stimulate projects, ideas, and understanding of research;
3. Provide leadership in research related activities . . . seminars, conferences;
4. Coordinate State education research efforts in the State agency and with other State government and professional agencies and professions;
5. Serve as consultants on research ideas and projects that forward vocational education;
6. Disseminate research information that enables others to utilize recent research findings;
7. Identify research training needs and personnel;
8. Work toward the identification of basic issues and problems needing research;
9. Develop long-range plans for research;
10. Gather or assist in gathering needed data for a potentially computer-based system of educational information;

11. Work closely with R & D Center and Project and U. S. Office of Education personnel in coordination of total research effort.

Continuous Activities to Date

The following list includes most of the continuous activities of the Wyoming RCU.

1. Review and collection of all available research literature.
2. Coordinate research efforts with the vocational education staff in all areas of the Department of Public Instruction.
3. Coordinate research activities with staff at the University of Wyoming.
4. Assist in the development of research proposals.
5. Contact educational agencies, business and industrial associations, State and Federal Government agencies, such as the Wyoming Employment Security Commission, Governor's Labor Force Survey Committee and others, to collect occupational information and research and to acquaint them with our activities.
6. Preparation of a foundation for vocational-technical education research needs in Wyoming. The RCU is making an extended study of research undertaken in Wyoming (of vocational-technical education and related areas) since 1960 that has direct application to vocational-technical occupational education (all levels).
7. Conducting a research personnel inventory -- surveying persons trained in research methods and statistics who are working on closely related vocational-technical education aspects.
8. Setting up RCU library -- gathering, classifying, and filing pertinent research reports, statistics, and other data for use in total Statewide R & D effort.
9. Preparation of a guide for writing and submitting research proposals at Federal and State levels.
10. Implementation of ongoing public relations program for RCU.
11. Soliciting research reports from other states for dissemination to interested persons, groups, agencies, etc.
12. Identification of basic issues and problems needing research in Wyoming.
13. Development of long-range research plans for Wyoming.
14. Gathering data for a computer-based system of educational information.

15. Establishing communication with RCU's in other states through exchange of reports, brochures, and other information including direct correspondence plus attendance at regional and national meetings.
16. Development and analysis of the cost of vocational education in Wyoming.
17. Continuous effort to coordinate research throughout the State.
18. Introduction of the Unit and its activities to the various segments throughout the State.

Concluding Statement and Projections

Considering the length of time which the RCU has been in existence, some activity has been devoted to normal organization and procedure development. These activities have been directed by the premise upon which the RCU is based. This basis is the belief that any educational agency is a service institution. In order for the State's educational agencies to provide services, they must first know what services are desired and needed and what procedures best fulfill their needs within their constituent areas. It is toward this end, that is, aiding educational agencies in determining the needs of the people and the best methods of fulfilling these needs, which the activities of the RCU have been directed.

BASIC RESEARCH METHODS IN VOCATIONAL EDUCATION

Robert F. Noble

Associate Professor of Music Education and Educational Research

College of Education

University of Wyoming

What Is Research?

What is good research and how does it differ from "innovation and tryout," and "purposeful trial and error"? Good research is generally identified by five characteristics: detailed preplanning, careful control, accurate measurement, predictive results, and determined objectives on the part of the researcher. Innovation, tryout, and purposeful trial and error usually do not incorporate the above-mentioned characteristics of good research. When the characteristics are used, they are not incorporated with degree of skill and determination which is characteristic of their use in good research.

Defining the specific problem is one of the most difficult tasks in applying research to the problem-solving situation. Applying the scientific method to the problem-solving task is the recommended approach for both professional researchers and for teachers engaging in part-time research. Applying the scientific method to the solution of any problem requires that the researcher first specifically state the nature of his problem. The second step involves searching for tentative answers to the problem and establishing the hypotheses. He must then test the hypotheses and select the one hypothesis which best fits the evidence. If one recognizes the applicability of the Law of Parsimony, he will strive for simplicity in the conclusion.

Where Is Research Today?

Since the launching of Sputnik, there has been a great deal of criticism directed toward all areas of American education. The results of such criticism has stimulated a great deal of research and has led to the discovery of new and better ways of teaching. The fusion of the new methods and approaches with the old methods and approaches has frequently caused education to come under the scrutiny of those who are affected by the changes.

Because of the great amounts of new knowledge which is continually being discovered in all fields, it has become obvious that teachers cannot cover all of the details in a subject-area. Research must be undertaken by individual teachers, in an effort to discover which concepts and principles should be covered in a course and which should be omitted. The overall long-range objective should be to give the students a firm background in a particular discipline so that they might advance on their own and seek the details in their area of specialization.

In the past, research has not been a very important segment of the educative process. In 1950, only five one-hundredths of one per cent of the nation's total school budget was devoted to research. Some school administrators are currently recommending that as much as ten per cent of the total school budget go into research. Although ten per cent is a somewhat idealistic figure, and we will probably never approach that level of emphasis in educational research, it does illustrate the trend toward greater emphasis in such research.

Characteristics of a Good Researcher

What qualities make a good researcher? I believe the first quality a good researcher should possess is that of being highly observant; he must be aware of what is going on around him. He should also be very objective and accurate in his approach to research. He must have the courage to stand behind his convictions, and should be willing to go out on a limb in representing his own ideas. A good researcher must be willing to involve himself in details, and should possess an innate curiosity to answer the question "Why?"

Methods of Research

Historical research. This is one of the oldest methods of research. Historical research includes much more than merely collecting facts and figures from a certain period of time; it also includes analyzing the data, arriving at conclusions, and drawing inferences. Good historical research almost always requires direct examination of the original materials or documents.

Historical research may be approached in either an internal or external manner. When the techniques of external appraisal are employed, the researcher attempts to determine the authenticity of a document, while internal appraisal deals with the truthfulness of the content of the document. The individual engaging in historical research should be aware of the potential dangers inherent in the approach: (1) decisions can easily be based on insufficient evidence, and/or (2) the data may be improperly selected.

Experimental research. Experimental research is concerned with both human and non-human data. In an experimental design, the researcher has a system of both qualitative and quantitative analyses which enable him to control his data collection process. In imparting such control, the researcher should incorporate "Mills Five Cannons," which were developed by John Stewart Mills. These include:

1. Method of agreement. This states that if the circumstances leading to a given event have in every instant only one factor in common, it is very probable that that factor is the cause of the difference. One of the problems with this approach is that it is frequently difficult to relate or locate all of the factors related to an experiment. The second potential problem is determining the significance of each factor, as related to the particular problem.

2. Method of difference. This method involves the situation in which all factors but one are alike. When that one factor is present a certain outcome occurs, and when that factor is absent the outcome does not occur. The method of difference is frequently used in experimental research.

3. Joint method of double agreement. This method utilizes the method of difference and the method of agreement, and measures the difference between

them. One of the problems associated with this method centers around the difficulty in obtaining situations which involve factors common to both of the preliminary methods.

4. Method of concomitant variation. This is when two variables are interrelated and move together in the same direction and at the same time. When this occurs, one of the variables is affecting the other, or they are both being affected by an outside factor.

5. Method of residues. Purposeful trial and error dominates this approach, as the researcher continually eliminates potential causal factors, until the true cause is determined.

Three different methods of experimentation are usually employed in educational research. These include the one-group technique, the parallel-group method, and the rotation-group method. The one-group technique is most common in educational experimentation because it disturbs the typical classroom situation less than do the other methods. In using the one-group technique, a single factor is either added to, or taken from, the study group, with the results being observed and measured. The major obstacle to using the one-group technique is that it is very difficult to limit the external factors which might influence the results of the study.

The parallel-group method involves a control group and an experimental group. An experimental factor, or variable, is applied to the experimental group, while the control group remains in the same relative position. Following the application of the experimental variable, the two groups are equated, with the differences being measured and interpreted. When the parallel group method is used in an experiment involving human beings, several potential problems may be anticipated. Because of the great difference in individual personalities, there is always a problem in equating and determining the control group and the experimental group. Teacher attitude toward student experimentation and obtaining large enough experimental and control groups can also pose problems for the researcher.

The problems associated with adequate sample size can sometimes be overcome by using either the co-twin or matched-pairs technique. The co-twin technique involves twin specimens, such as twin sheep or twin cattle. Although researchers occasionally work with twin human beings, it is very difficult to find an adequate number of twins in the same period and in the same class. The matched-pairs technique involves pairs of individuals who are as much alike as possible, with experimental factors being applied to one group and not to the other.

With the rotation-group method, several experimental groups are selected and each experimental factor is applied to each group on a rotation basis. The effect of each factor on each group is then measured. This method is frequently used and is quite effective because it is possible to identify external causal variables in individual groups.

Normative Survey

The normative survey method of research is the most common type of research in education. It is also known as a descriptive study, status study, and simple survey study. This method is used to determine existing conditions and/or to determine the frequency of particular behavior items. The greatest disadvantage of the normative method is that it merely describes conditions as they are; it does not determine "what should be," or "what is best." The fact that a majority of people are in favor of doing something a certain way does not necessarily mean that their method is the best.

Interview. The interview is one of the most satisfactory techniques of the normative survey. This technique is especially valuable if the researcher is seeking to determine individual likes and dislikes. It enables the researcher to obtain direct answers from his study population and allows him to observe the amount of thought devoted to each response.

Questionnaire. The questionnaire is usually the least expensive way of obtaining research information. One of the major problems associated with the questionnaire concerns the researcher's difficulty in appraising those who respond.

Questionnaires are usually recognized as being either open-form or closed-form. This categorization is based on the form and style of the questions. With the open-form, the respondent writes out his own answer to each question, while the closed-form has a limited number of responses which are checked by the respondent. Although the open form frequently gives a better indication of the respondents' true feelings, it is more difficult to tabulate than the closed form. Occasionally, a researcher will combine the open and closed forms in an effort to build more flexibility into a questionnaire.

Opinionnaire. The opinionnaire seeks the respondents' candid opinion on certain items of interest. The information obtained from opinionnaires is frequently of limited scientific value, as responses are often on the spur-of-the-moment and do not reflect the respondents' true feelings. It is, however, used as a "sounding board" on critical issues. From this type of initial exposure, other kinds of research may be developed.

Other types of instruments used in normative surveys include: survey testing, survey appraisal, documentary frequency, observation, and directed observation.

Case study. The case study is used most frequently by guidance personnel and others who are concerned with human behavior, growth, and development. Methods employed in the case study include the interview, longitudinal analysis, and cross-sectional analysis. When the longitudinal technique is used, a relatively small group of individuals are observed over a long period of time--usually for more than three years. Cross-sectional analysis involves the immediate and limited observation of several different age groups.

Correlation Research

Correlation research applies statistical analysis in determining the relationship between two measurable items. One of the potential problems in this area is that the mere fact that two items vary together does not mean that a change in one item will cause, or is caused by, a change in the other item. Both analytical and predictive statistics are used in correlation research.

Action Research

Action research is on-the-job research, where the researcher is primarily concerned with information and results as they are related to him. Action research is not as intent, scientific, or controlled as closely as pure research. In terms of practicality, however, action research is of great value to the individual teacher or novice researcher who is primarily concerned with solutions to his own problems.

Action research is frequently applied on a vertical basis, such as determining the effectiveness of a language arts program in kindergarten through the sixth grade. An example of action research on a horizontal basis would be for all sixth grade teachers in a school system to group their experiences together in an effort to develop greater continuity in their total program. In actuality, the application of action research is limited only by one's imagination.

BASIC ASPECTS OF RESEARCH

Dr. James R. Beck

Associate Professor of Educational Foundations and Research

College of Education

University of Wyoming

This afternoon I would like to discuss with you the topic: "Basic Aspects of Research." This involves attitudes toward research as well as the mechanics of research. Considering the area of attitudes first, let's look at the question, "what is research?"

Research is a way of getting knowledge and of trying to find out what is true. The methods used to obtain knowledge may be through revelation, intuition, faith, or the scientific method. In actuality, research is the scientific method personified. The research method of acquiring knowledge differs from the other methods in that it possesses the discipline of testing openly and publicly. In research, one must verify what is said through evaluation. At the same time, however, we must realize that the stimulus for some of our best scientific discoveries originated in the form of hunches, guesses, and intuition. The information from such sources is considered research only when it has been submitted to public examination and/or testing.

We can define research as being the way of integrating all knowledge and subjecting it to investigative methods limited only by the creativity of the individual. Evaluation of the results must then be open to the public who will evaluate that knowledge in terms of the criteria which they have for judging such research findings. The criteria which the public uses for its evaluation formulates the subjective aspect of research, as it is obvious that not all who examine the data are going to arrive at the same conclusions. At the same time, the researcher's findings will be accepted by the public as facts only when they have accepted the criteria which has been established by the researcher.

The most basic assumption which must be made by the researcher is that all areas of knowledge are subject to investigation. When we consider the purpose of research, explaining new phenomena or behavior by investigation of causes, we can better see the need to keep all areas open to examination and research. Once we have discovered a new fact and explained it, our next task is to attempt to predict it, which is soon followed by our desire to control the behavior we have discovered. This is in direct conflict with those who see the controlling of a behavior as taking away man's freedom of choice. That leads to a basic question of values, which does not directly pertain to the topic at hand.

What are some of the most pertinent problems in research today? The first problem which stands out in my mind is the "sloppiness" of researchers in defining a problem. This sloppiness is usually the result of not adequately studying the background information which is related to the problem. When this happens, researchers move away from the procedure of being honest and objective in gathering and interpreting the facts. They then consider the results to be proof that the research was accurate and adequate. By accepting such logic, researchers have forgotten that the truth is never proven by research, but instead research merely allows us to reject certain falsehoods.

A second basic problem of research involves the application of the results of pertinent research. It takes time, resources, and a great deal of creativity to apply newly-developed research. To further complicate the problem, some research findings do not lend themselves to be easily applied to practical settings.

The two general categories of research are basic and applied research. Basic research is the search for knowledge without trying to develop a way of applying the results of the research. The researcher has the creative freedom to discover new relationships, new workable elements, and other similar factors. He leaves such findings for someone else to apply at a later date. The long-range value of such research cannot be doubted, although the immediate value and pertinence is frequently questioned.

As contrasted with basic research, applied research is initiated through, and centers around, a recognized need. The research concentrates on that need, with the various alternatives being carefully weighed and compared. The end result is the recommendation of the best alternative solution, and the application of the recommendation to the problem at hand.

One of the most acute problems facing the practitioner is related to having enough time to read the voluminous amounts of material that come to the teacher from all sides. When the practitioner does find time to read the material, he frequently finds the vocabulary to be unfamiliar, thus leading him to be consciously or subconsciously suspicious of the results of the research.

Several years ago the concept of the "50 year lag" was proposed. This concept suggested that the lag between the time when research findings are made and when they are applied constituted a 50 year period. In order to help disseminate research findings and to help eliminate the gap, research laboratories were established throughout the United States by the federal government. A recent evaluation of the resulting progress was made by a group from Northwestern University. The results of their study indicated that the "50 year lag" no longer exists. Instead of recognizing the continued presence of the "50 year lag," the Northwestern study discovered that, in general, the findings of the research laboratories were so contaminated, the methods used were so sloppy, and the results were so contradictory that they had little value relative to their original purpose.

It was also discovered that there was very little effort to correlate and to coordinate the research which was being done at the various laboratories. Long-range studies were considered to be ineffective because the researchers had failed to consider the practical application of their research to the problems in the field. The most pressing problem which was discovered was the failure of the research laboratories to develop a feeling of confidence between the rank and file professionals in education and the individuals in the laboratories.

Generally speaking, the research which has been done in the area of education has been quite primitive. Great volumes of research information have been compiled, but only a relatively small amount has been applied to real life situations. Educational research has failed in three basic ways. First of all, it has failed to help education significantly improve the individual and society, because of the complexities involved in evaluating the thinking process. A second barrier has been the unwillingness of many educators to accept the basic assumptions of educational research. The third reason education has not been optimumly enhanced by research has been because of the lack of proper dissemination of values which have been developed by the research method.

The failure of proper dissemination can be attributed to four frontier values. First, many of the values which are developed by research frequently conflict with the values already held by educators. This is partially due to the general feeling among educators that all values must be absolutes. Unfortunately, values are not settled. An example of this is our changing concept of democracy. In reality, democracy has moved toward socialism in recent years. While the basic concept has remained in abstract form, it has constantly been changing with the changing demands of society.

A second factor is that our morals are in a constant state of flux. This frontier value is in a state of change throughout the country, and is not confined to educators who have long held certain values to be fixed.

The third frontier value can be found in America's desire to see results when changes are put into practice. This pragmatic point of view frequently does not hold up when we apply research developments to the educative process. Concrete results from new ideas and methods frequently do not appear for several years. Also, rapid changes in society may distort the values intended to be developed in long-range projects.

The fourth frontier value which impinges the proper dissemination of research developments is derived from the fact that education is a "value job." In order for a child to learn, he must first be motivated to value the principle or skill which is being taught to him. The basic problem associated with teaching a principle or skill centers around the teacher trying to present fixed moral values to his students, while the pressure of society is attempting to change such values. In order to develop a motivation for learning, these values must be verified by research.

If educators are going to effectively use research in education, and help promote the goals of education, they must first adopt an attitude of openness with regard to values. There must be a verification of the values that have in the past been held as being fixed. If there is a change in such values, the latest results to be verified must be accepted. An attitude of total openness, together with an enthusiastic approach to verifying both old and new values must transpire if education is to improve the position of the individual and of society.

PROGRAM EVALUATION AND REVIEW TECHNIQUE FOR EDUCATIONAL RESEARCH PROJECT DEVELOPMENT AND CONTROL

William H. Nightwine
Assistant Director, Wyoming Research Coordinating Unit
State of Wyoming
Department of Education

The two decades since the termination of World War II have witnessed increased emphasis on research and development activities in almost all areas of the economy. Research and development has always existed in an advancing technological society, but it was during the years of conflict that initiation of such broad, large-scale research projects as the Manhattan project, dealing with complex and often relatively new concepts and ideas, began to reach fruition. While industry has been concerned primarily with research and development relating to the development of new products and improvement of those existing, or the creating of new markets, the emphasis given to basic research has been much less impressive. The government, on the other hand, has utilized both basic and applied research and development for the design of new military weapon systems. More recently, government-industry partnership in conducting large-scale research and development activities has been stressed.

The advent of a new "look" in research and development activities has created many problems for project managers and personnel. In general, achievement of a stated goal depends upon how well the end objective has been specified, past experience in accomplishing such goals, and the application of resources. For example, successful completion of a vacation trip to a specified site is more likely to succeed because of prior experience with such an undertaking; however, in putting a man on the moon, a low initial probability exists because of relative inexperience even though the goal is well defined. Probability of success with either increases with the excellence of any "road map" used.

Since numerous historical accounts of the development of PERT exist, the subject will not be repeated here. Background information appears in summary reports prepared by the Special Projects Office of the U. S. Navy and in an article by Malcolm and others. PERT is a methodology for planning many diverse activities regardless of their nature, and will be useful in either small or large projects. Because of its reported successful application to widely diverse activities (e.g., house construction, missile development, Broadway plays), its potential usefulness to the management of educational research and development activities has been recognized

The Management Process

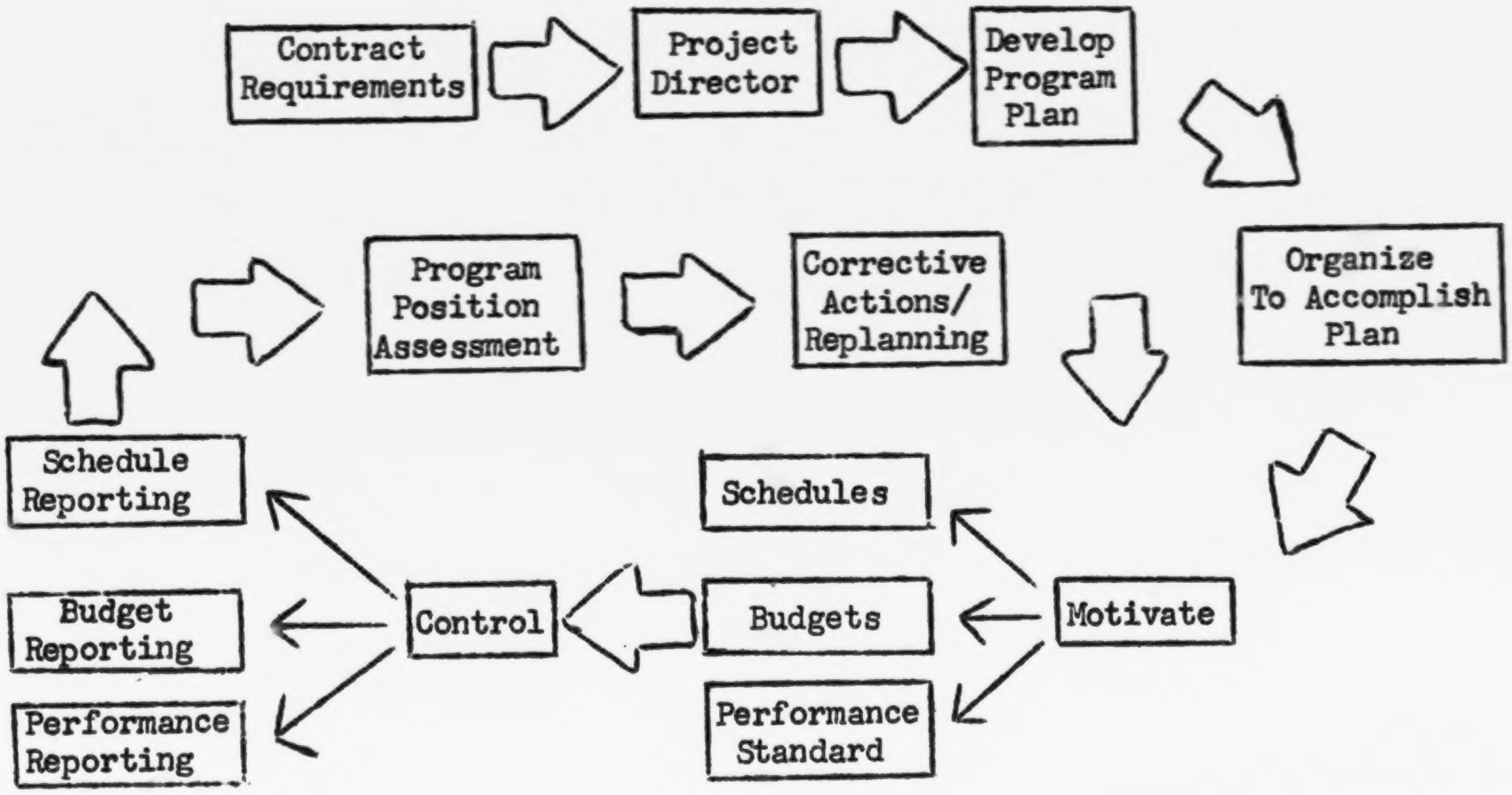
The process involved in moving from initiating a project or program to the final objective consists of several broad procedural steps. While some variation may result from uniqueness of an individual project, the general activities involved in management are illustrated in Sup. A, Figure One.

Planning - Before any project is initiated, the major and subordinate objectives must be identified in order to accomplish the overall objective. In addition, project objectives msut be presented to staff members. Project objectives may consist of equipment, decisions, facilities, data, or services.

A general process for determining objectives is to proceed by a "top-down" approach, asking just what end items, operational systems, or services the project is to produce, and each of these will be further subdivided by ascertaining what facilities or services will be needed to complete each objective.

Organizing - Successful accomplishment of a total project depends fundamentally upon the establishment of a plan designed to reach major and minor objectives. Accomplishment of a program goal can be reached by any one of

Sup. A - Figure 1 - The Management Cycle


Contract Requirements
Project Director
Develop Program Plan
Organize To Accomplish Plan
Program Position Assessment
Corrective Actions/ Replanning
Schedule Reporting
Schedules
Budget Reporting
Control
Budgets
Motivate
Performance Reporting
Performance Standard

several possible plans, with broad latitude for flexibility in planning. Planning is interpreted here to include not only a careful definition of program and objectives but also the effort involved in determining specific work or tasks and establishing the sequence and dependency existing among the tasks, along with performance standards or quality control levels. The goal is to achieve an optimum balance between schedule, costs, and performance requirements.

Once the plan has been established, calendar dates and times can be ascertained for start and completion of each element of the plan within allowable time periods; this process is referred to as scheduling. Once duration times have been allocated, manpower requirements can be determined.

Motivating - After planning and organizing are accomplished, the motivation of personnel will be of primary importance. This management step will include communicating project goals, directing assignment of tasks between departments and/or persons providing competent leadership, assessing staff morale, and similar actions. Good management involves communication between all levels of management, from the main project supervisor down to the line supervisor. Involvement of all concerned departments and personnel in planning and organizing functions will bring rewards in terms of increased morale and better production.

Controlling - Once the project is underway, management must be kept fully informed of the status of the work on a regular basis and upon request; deviations must be called to the attention of management along with recommendations for corrective action. Controlling is the process of action by management in response to deviations from the schedule.

Integrated Management System

Any system or technique designed to aid management must facilitate manipulation of three common dimensions of a project: (a) time, (b) cost (or resources), and (c) performance.

The time dimension consists basically of those aspects of a project relating to the time that each work element is expected to consume plus the total time for finalization of the project. Time overruns on individual activities can delay the end completion date. Time underruns, on the other hand, while leading to early completion, might reflect inefficient application of program resources and/or inadequate program definition.

The cost dimension involves allocation of resources (men, materials, equipment, and money). Consumption of materials and manpower at a rate faster than planned might result in a cost overrun or over-expenditure of budget for the total project. On the other hand, a decision to spend faster in order to achieve an early completion target may have no adverse effects on the project.

The performance dimension refers essentially to levels of quality stated as end objective specifications. For example, developmental specifications for a school test might require that it have a test-retest coefficient of .90 based upon a one per cent national sample of high school seniors.

Applying Management Concepts to Education

Research and development projects possess certain common characteristics regardless of their individual nature. Each research and development project has a starting and end point, with the latter usually being carefully delineated. To reach an end objective, a series of tasks must be accomplished in some prescribed order. Since many persons and/or organizations are involved, some type of coordinate effort must be arranged. This is particularly true in Wyoming due to the relative isolation of population centers and the subsequent distance between cooperating agencies. Furthermore, much uncertainty will exist with regard to the nature of tasks to be performed and the time available. Such projects are sometimes referred to as "once-through" activities since the project may not be repeated unless it develops into a routine and production-type undertaking. Also lacking will be guidelines such as full historical and background information and standards for determining time, sequences, and methods of reaching goals.

Perhaps the most cogent reason for examining management concepts centers around the evolutionary change taking place with regard to funding of the educational research and development effort. During the past decade, the amount of research support available for educational activities has grown tremendously. Hungate noted that $30 million were available from various sources in 1954, $50 million in 1958, and almost $1 billion in 1963. Recent legislation by Congress has further increased funds.

Extensive funding of research and development has resulted in a change in the nature of projects in that they are becoming much larger and more complex in scope, and often involve a research team as opposed to a single researcher. This team approach is handicapped in Wyoming because in some cases the team members are separated by geographic distance as well as by agency or institution.

Not uncommonly, government-funded educational research and development projects are from 3 to 5 years in duration, involve a staff of 10 to 15 persons, and cost in excess of $500,000. The project director in this situation becomes a manager as well as a researcher. Whatever his personal desires might be, he must spend increasing amounts of time in the management process. Some aspects of his responsibilities are assumed by campus agencies such as research foundations, but in the long run, they serve primarily as facilitative agencies which can contribute significantly to the effectiveness of a researcher. A system which would assist managers of large as well as small projects in determining and controlling time and costs might allow more time for research and lessen time devoted to management.

The purpose of this presentation is to present a technique developed for one aspect of research and development-project management. This management information system is known as Program Evaluation and Review Technique, or PERT. The Wyoming Research Coordinating Unit has found the technique to be significantly useful in the development of proposals, internal management of projects, and as a tool it can be used in evaluating a proposed plan for research. In view of PERT's success in effective program management in many areas of government funding, it is not unreasonable to assume that such a system would be required as part of educational research and development projects or programs. Expenditures within the jurisdiction of the Department of Defense include PERT or other formalized management systems as an integral part of the procurement cycle.

Work Breakdown Structure

The use of PERT as a technique for project management begins with a definition of project objectives. The Work Breakdown Structure, which reflects a top-down approach to planning, should serve as the initial step in project development. This process consists of subdividing a proposed project into smaller and more easily managed elements. The process of subdivision and classification continues until the desired level of detail is reached.

A Work Breakdown Structure may be developed using the format illustrated in Figure 2 showing four major work units under Level (1), the components of each unit under Level (2), and the work packages under Level (3). Some components are not broken down at the third level because they are considered to be small enough for planning and control at Level (2).

Figure 2 - Work Breakdown Structure for a Simple Survey Project

	LEVEL 1	LEVEL 2	LEVEL 3
Survey Project	Objectives	Problem Delimitation Hypotheses Data Paradigms	
	Survey Design	Instrument Development	Item Construction Format Design Direction Preparation Cover Letter Preparation Tryout Item Revision Final Form Production
		Field Operations	Travel Arrangements Interviewer Selection Reliability Check Follow-up Procedures
		Sample	Sampling Plan Tryout Sample Final Sample
	Data Analysis	Coding System Data Reduction Statistical Tests Interpretation	
	Documentation	Narrative Tables/Graphs Bibliography	

Network Development

A network is the foundation of the PERT system. It shows the plan established to reach project objectives, interrelationship and interdependencies of project elements, and priorities of the elements of the plan. In essence, the network is a graphic representation of the project plan.

Determination of the networking system is ascertained by the project work breakdown structure which must be constructed as an initial step in project planning. For relatively simple projects, the use of a single network may suffice. In complex programs, a master network will be developed depicting the total program.

The complexity of the work breakdown structure will then provide the basis for establishing the number and type of subnetworks. For exmple, subnetworks may be constructed for each one of the first-level program elements, or if the project is sufficiently complex, for each of lower level elements. Each subnetwork is an expansion of the detail in a particular of the master network.

A network is composed of events and activities. Events represent the start or completion of an activity and do not consume time, personnel, or resources. Events are instantaneous points in time when an action has been started or completed.

The following are examples of event descriptions:

Start sample selection.
Start test item analysis.
Start writing curriculum guide.
Complete statistical analysis.
Complete enrollment survey.
Complete literature review.

The general practice is to represent events in a network by the use of circles. Squares, rectangles, and other symbols are sometimes used to designate project milestones or most important events.

In the event that more than one network is developed for a project, the use of interface events will be necessary. An interface event is an event signaling a necessary transfer of responsibility, information, or end items, from one part of a plan to another. These events tie the subnetworks and master networks together in a single structure for purposes of total program planning and control.

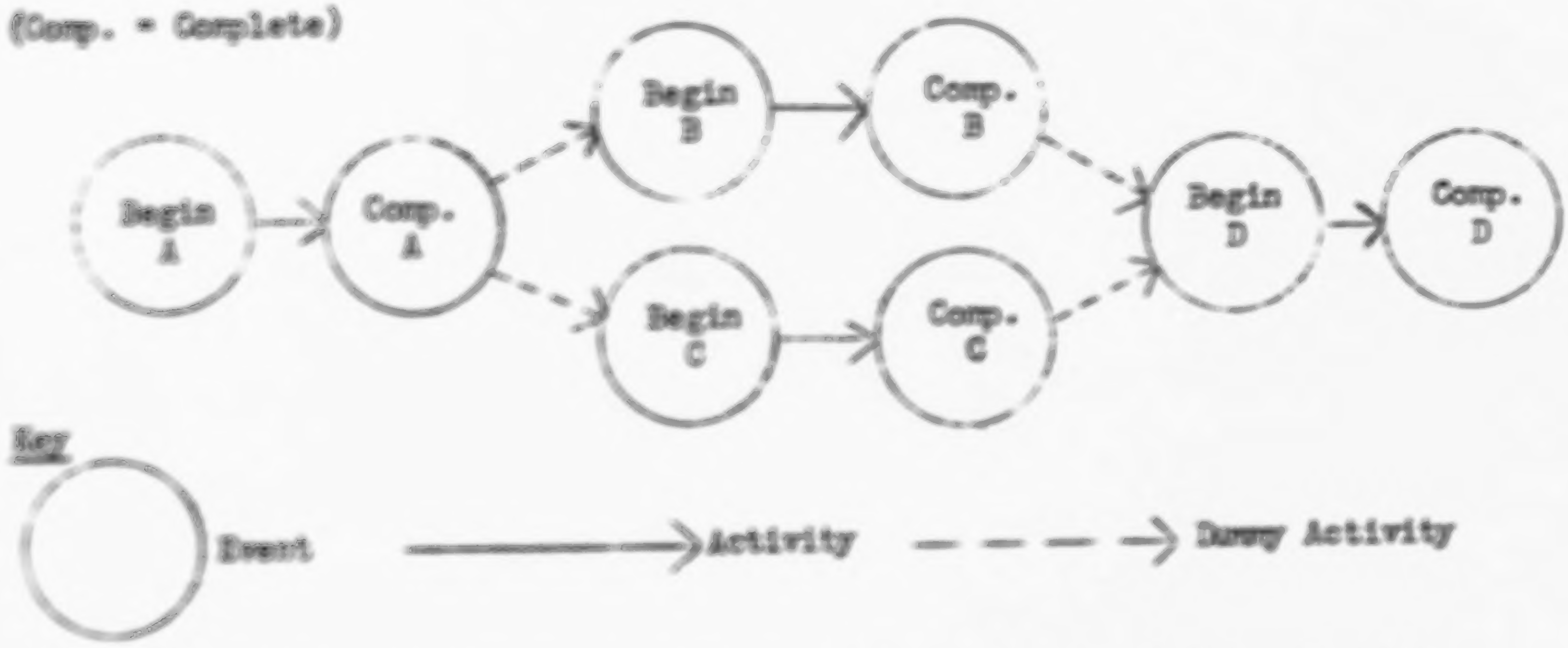
An activity is a task or job in the project requiring utilization of personnel and resources over a period of time. An activity consists of the work processes leading from one event to another. Activity descriptions must be as definitive as possible in order that work responsibilities can be assigned, realistic time estimates can be made throughout duration of the activity, and users of the network may understand the purpose of each activity in the whole scheme.

The following are examples of activity descriptions:

Select statistical technique.
Keypunch data cards.
Write questionnaire items.
Hire new staff.
Install audiovisual equipment.
Design test manual.

An activity is represented on the network by an arrow connecting one event with another. Dummy activities--those which do not consume time or resources--are represented by dotted arrows. An example of a simplified network is shown in Figure 3.

Figure 3 - Simplified Network Showing Events, Activities, and Dummy Activities



The first step in constructing a network is to place project work units, as identified in the Work Breakdown Structure, in their logical order. Supporting events and activities may then be added to form the network.

The question of whether a network is constructed from the beginning to the end event (left to right or forward), or from the end to the beginning event (right to left or backward), somewhat depends upon the uniqueness of the project. If elements of the project are fairly well known and defined, a forward-type construction might be employed. On the other hand, a backward construction forces the user to consider what activities and events must take place before project objectives can be accomplished. Whichever method is used, the flow of the network always moves from left to right.

Dependency and constraint are fundamental concepts of network construction. A dependency or real constraint exists when one activity or event cannot take place until the events and activities preceding it have been completed. Planned constraints, however, are those event/activity relationships which have been established as a desirable but not absolutely necessary program relationship.

The clarity and accuracy of a network depends upon the illustration of start and completion of each activity included. This is done through the use of "start" events, "complete" events, and dummy activities. If an activity cannot start before a preceding activity is finished, only start or complete events need be indicated. However, if one activity can begin before the preceding activity is completed, both the start and completion events must be shown.

Activity Time Estimation

After the network has been constructed and its logic approved by users, the estimated time to complete each step is secured. A single time estimate may be secured for the expected duration of an activity, but the more usual procedure is to secure three time estimates in cases where uncertainty regarding work scope must be considered. These three estimates are known as the *Most Likely Time*, the *Optimistic Time*, and the *Pessimistic Time*.

The *Most Likely Time* is that which, in the estimator's judgment, the activity will consume under normal circumstances. The *Optimistic Time* is the least amount of time the activity will take under the most optimum conditions. This estimate assumes that work involved in an activity will progress with exceptional ease and speed, but, would have no more than one chance in a hundred of being completed in this time. The Pessimistic Time assumes that anything that can will go wrong, short of acts of God. This estimate should take into account the most adverse conditions including the possibility of failures occurring which require new starts. This time estimate also has no more than one chance in a hundred of occurring.

The validity of time estimates will depend to a large degree on how well the activity is defined. Since the validity of output data from the PERT system depends directly on the validity of time estimates, activity definition becomes quite important. Vague or gross activity definitions are difficult to time precisely.

The uniqueness or newness of work involved also will affect time estimates for an activity; if operations have been performed many times before, these estimates may have a very small range, such as 4-5-6. It is even possible that values of the three estimates may be the same if the nature and duration of an activity are well established. On the other hand, unique and seldom performed activities will be characterized by time estimates with wide ranges, such as 2-6-12. This uniqueness of tasks and activities is inherent in many research and development efforts, and the three time estimates are intended to allow for this uncertainty. Other conditions usually prevailing are:

1. Time estimates assume that resources (including personnel) will be available on a normal basis or as requested in the project proposal.

2. Time estimates are based on a 5-day work week and are established by weeks and tenths of weeks. A time estimate of 0.1 week would be equivalent to 1 day; and so forth. Other time units may be used, but the week and tenth of a week are most common.

3. Schedule or calendar dates should have no effect on initial time estimates. By ignoring present calendar dates, the estimator avoids biasing his estimates in favor of these dates.

In many project situations, the amount of time available for completion of a project is either less or more than that estimated to accomplish the project in a desired manner. When available time is less than estimated time, negative slack will exist along some or all network paths. The slack condition arising when time available is greater than estimated time is referred to as positive slack.

Activities on the Critical Path in the network provide the most rigid time constraint on completion of a project. The project director must focus his attention primarily on this path rather than upon those less critical. This feature of PERT provides a means of identifying critical areas or paths of the project which might go unrecognized until too late to prevent serious time slippages and costly overruns.

Scheduling

The initial planning and time estimating for network activities purposely ignores calendar dates in order to avoid biasing time estimates in their favor. While the time estimates provide a framework for beginning the scheduling process, they do not supply all information needed.

The scheduling process is initiated by assigning a scheduled date to significant events in the network. A scheduled date assigned to the end event must be the same as, or earlier than, the required project completion date. For example, data must be collected from students before Christmas vacation begins in 8 weeks. The project director, however, can assign a completion date of 6 weeks in order to offset unforeseen delays. In PERT terminology, a date imposed by the school vacations is called a Directed Date in order to distinguish it from a Scheduled Date established by the project director.

Further scheduling is done by assigning Schedule Times to activities in the network which may be the same, less, or greater than the expected time. The value of the Schedule Times is dependent largely upon the project director's experience and knowledge concerning the activity. Project schedules should be disseminated to personnel at the earliest possible time.

Several considerations are involved in scheduling a project, one being the real constraint imposed by availability of personnel, equipment, facilities, and other resources. For example, the use of elementary or high school students as subjects in a project usually is restricted to the months between September and June.

Another consideration involved is the desire for optimum utilization of personnel in order to avoid overtime or wasted hours. For example, project management could attempt to level manpower requirements by taking advantage of network slack, thus avoiding severely fluctuating manpower requirements. This is important because services of specialized personnel in an educational research and development project are often costly. If the nature of a project is such that these specialized services could be spread over the life of a project, or a large part of the project, rather than being peaked at some mid point, the project director might be able to devise a more realistic utilization of personnel. In some cases, the nature of a project could require specialized personnel and/or intermittent help, creating necessary high and low periods of manpower application. The utilization of PERT enables a project director to schedule well in advance all peak period personnel requirements.

Limitations of time and budget imposed by a funding agency also will affect scheduling of the project. For example, a project proposal may request a January 1 starting date. If the funding agency imposes a different date, such as April 1, the project director must internally schedule his project to meet this external requirement. Additionally, the funding agency or "customer" may impose other requirements that will affect the project schedule. For example, in a proposal to organize a foreign language curriculum for grades 1 through 4, the funding agency might ask to have grades 5 and 6 included. Such a request probably would add time and money to the original project plan and require modification of the schedule.

Finally there is the judgment of the project director as to reasonable time allotments for the various activities. If he knows that certain persons or departments tend to make pessimistic time estimates, he may impose schedule requirements inconsistent with the estimates based on past experience and judgment. Although no firm ground rules have been established for interpreting probability data, 50 percent probability for event completion on schedule is considered ideal. Events with a probability of 84 percent or higher are considered undesirable as are those having less that 15 percent probability of occurrence. Some PERT analysts view the 15 and 84 percent points as permitting too broad a band of deviation and, therefore, recommend 25 and 75 percent as "cut-off" points for low and high probability.

Because of the relative complexity of the mathematical and statistical aspects of the probability concepts of PERT, that information has been deleted from this section.

Replanning the Project

It is not uncommon in the first "run-through" of a network to obtain undesirable probability and slack conditions, usually resulting from a wish to establish an "ideal" project plan. When the ideal is not practical in terms of funding limitation, certain established generalized procedures can be applied for replanning networks, as follows:

1. Removal of Planned Constraints - Planned constraints are those activity/event relationships which have been established as desirable but not absolutely necessary program relationships. Many such constraints normally are established in the formulation of an ideal project plan; removal of the least significant will constitute an important first step in replanning.

2. Parallel Activities - Activities that are in sequential or linear order can, with the introduction of some management risk, be conducted in parallel. The decision to parallel activities will depend largely upon the availability of required resources, as well as the degree of risk that the project director considers acceptable.

3. Eliminate Activities - The project may contain activities whose accomplishment might be desirable but possibly more time consuming than is permissible. If not essential, they can be eliminated.

4. Reallocate Resources - The addition of resources (personnel, equipment, or material) to activities along the critical path usually will result in a reduction of activity times along this path. Thus, significant negative slack may be removed. In using this technique, a determination must be made that the time saving will justify the increased cost.

5. Redefining Activities - The original plans will often contain activity descriptions that represent gross amounts of work. Careful examination of these gross activities often may reveal specific activities which can be assigned a shorter cumulative time estimate compared with the original gross activity. Further definition can take place in terms of performance levels for an activity. For example, in the case of a statistical study, a smaller sample than was originally planned might be taken.

It is important to stress that activity time estimates must not be shortened or "crashed" arbitrarily to meet a scheduled or directed date. Such a procedure would invalidate PERT as a useful management tool.

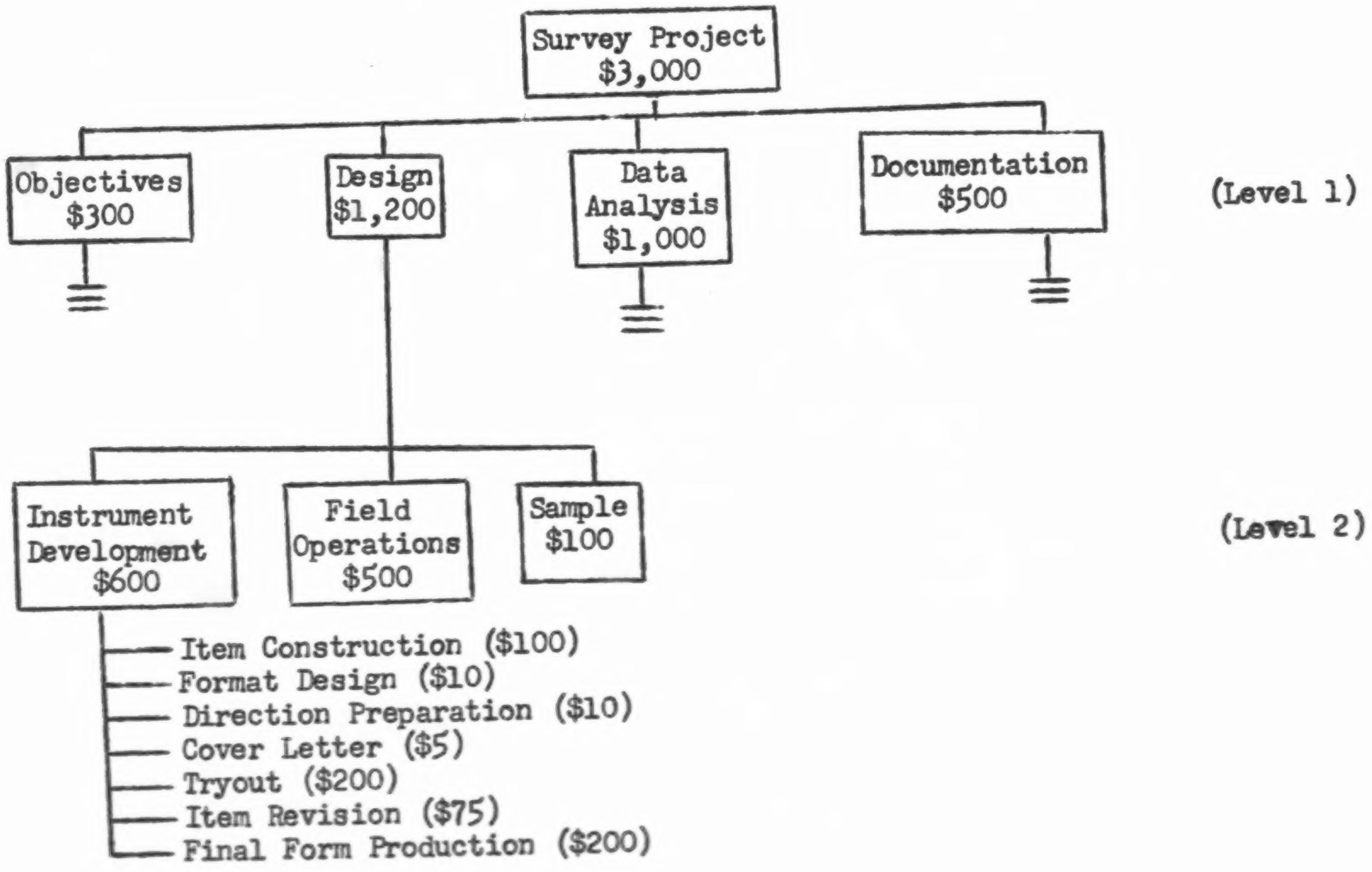
Introduction to PERT/COST

Principle objectives of the PERT/COST system are to aid in development of a more realistic project estimate; to compare estimated and actual costs at any selected point in the program; to help determine the best allocation of resources to project activities; and to forecast total project costs based upon program cost position throughout the project.

Cost estimates for a project should start when the work breakdown structure has been formulated, and should be based upon program elements and work packages depicted by the work breakdown structure. Although individual activities in a network may be cost estimated, this is considered to be a burdensome and time-consuming procedure for large networks.

In order to find the total cost estimate for the project, estimates are summed from bottom to top in the work breakdown structure. Figure 4 illustrates this procedure. The total cost for all elements in the work breakdown structure becomes the total estimated project cost. The collection of actual costs into the same work packages allows a direct comparison of estimated versus actual expenditures.

Figure 4 - Summarization of Work Package Cost Estimates for Total Project Cost


Survey Project $3,000
Objectives $300
Design $1,200
Data Analysis $1,000
Documentation $500
(Level 1)
Instrument Development $600
Field Operations $500
Sample $100
(Level 2)
Item Construction ($100)
Format Design ($10)
Direction Preparation ($10)
Cover Letter ($5)
Tryout ($200)
Item Revision ($75)
Final Form Production ($200)

VOCATIONAL EDUCATION RESEARCH AND GOALS IN UTAH

John F. Stephens

Director, Utah Research Coordinating Unit

Utah State Board of Education and RCU Organization

In order to better realize and understand the goals and current research activities in vocational education in Utah, I am going to first briefly outline the governmental organization of Utah's educational system. Unlike many states, the Utah State Board for Vocational Education and the State Board of Education are one in the same. The citizens of the state elect the Board members in bi-partisan elections. The State Superintendent of Public Instruction is the designated executive agent of the Board. His tenure tends to add a needed element of stability to the overall organization. The State Superintendent has three Deputies: the Deputy Superintendent of Instruction; the Deputy Superintendent of Administration; and the Deputy Superintendent of Institutions. This afternoon, our primary area of interest will center around the duties of the Deputy Superintendent of Instruction, as they pertain to vocational education in the State of Utah.

Under the Deputy Superintendent of Instruction are several sub-divisions, including the Division of Vocational and Technical Education. The head of this division has a number of technical advisers who relay technical information to him in the fields of Home Economics, Industrial Arts, Vocational Agriculture, Trades and Industries, Distributive Education, Business Education, and other related areas.

The Utah Research Coordinating Unit is included in the Division of Research and Planning, which is one of the sub-divisions under the control of the Deputy Superintendent of Administration. By viewing the organization structure, it would appear that difficulties would arise as a result of the Utah RCU being under an entirely different chain-of-command than the area it is serving. The system has worked very efficiently, however, because of the permissiveness and understanding of the individual directors and the other persons who are involved and/or affected. Because of the attitude of the Director of Research and Planning toward research in general, and toward the activities of the RCU, information for, and communication with the Division of Vocational and Technical Education has not been impeded in reaching the proper channels.

The personnel in the Utah RCU includes the Director, Associate Director, "contact personnel," consultants, and seven graduate assistants. The graduate assistants are on the regular payroll of the RCU, and usually serve as investigators, statisticians, and project operators. The "contact personnel" are usually graduate students whose thesis or dissertation topics are especially pertinent to one of the areas in vocational education. When such an interest exists, and the student has sought partial funding of his project through the RCU, he will frequently receive enough funds to cover most of the direct costs of his study. The consultants are usually instructors at the various institutions of higher learning throughout the state, although independent statisticians, sociologists, anthropologists, and other specialists occasionally serve as consultants.

RCU Objectives

The overall objectives of the Utah RCU can be broken into three identifiable segments. Short-range projects constitute one of the main objectives of the Unit. These projects are aimed at filling the immediate needs of the state's vocational specialists. The short-range projects are usually not conducted in a laboratory-controlled environment and usually do not entail "pure research." Rather, they are oriented to the "action research" approach. They are concerned with particular problems in particular situations.

The longer-range projects are chiefly aimed at helping to design proposals and to take appropriate steps in the procurement of Federal funds for major projects in research and other areas of vocational education. If an individual or organization has a constructive idea for a major project in the area of vocational education, the RCU will provide consulting services in the preparation and submission of the Federal proposal.

The third area of emphasis in the Utah RCU centers around the current effort to build programs which will eventually teach vocational teachers and administrators how to conduct their own research projects. It is anticipated that through these programs of instruction, we will directly and indirectly stimulate a greater interest in conducting research in vocational education at the "local" level. Associated with the third objective is the desire to eventually coordinate the smaller research projects into an all-encompassing program.

Utah RCU Funding Procedures

The research projects which are submitted to the Utah RCU are funded through Title 4a of the Vocational Education Act of 1963 and through state matching funds. The screening process for selecting those projects which will be funded is not nearly as complex as it is for funding most Federally-connected programs.

If the cost of a proposed project is less than $500, it must be approved by the Director of the Utah RCU and the State Specialist in the particular area of interest. The State Administrator of Vocational and Technical Education must then approve the project before a project director can be designated and a principal investigator can be hired. If the cost of the proposed project is more than $500 but less than $10,000, the same basic procedure is followed, with the addition of one more screening step. If the RCU Director and the appropriate State Specialist approve the project, it must then be approved by a majority of the Vocational Specialists in a joint meeting. It then moves to the last step of the screening process--the State Administrator for Vocational and Technical Education. Those projects which cost more than $10,000 and last for more than 18 months are referred directly to the U. S. Office of Education in Washington, D. C. Long-range projects which cost less than $10,000 are referred to the regional office in Denver for consideration.

Vocational Information for Education and Work (VIEW)

I would like to briefly discuss a new technique we have been experimenting with in Utah, which is aimed at disseminating occupational information to high-school students. This new program is called "VIEW," which stands for Vocational Information for Education and Work. The purpose of VIEW in Utah is to provide up-to-date information for tenth-grade students about non-baccalaureate-type jobs in Utah. The information is written in a language which is meaningful to tenth-grade students, and is in a format which is both interesting and easy to update.

The program centers around the utilization of such modern equipment as a camera-processor, which reduces pages of information to micro-plate master cards. The micro-plate master cards can then be used to produce an unlimited number of copies of the information by running the cards through a "uni-printer." The information can be disseminated to the high-school students by either sending out copies which have been produced on the "uni-printer" or the information may be read off a master card and viewed through the screen of a "reader." The "reader" screen has the outward appearance of a television screen.

The index for retrieval of the vocational information is listed four different ways: a) alphabetically by occupational title; b) by vocational field; c) by job characteristics; and d) by personal interest and/or ability. An example of the type of localized, as well as general, information which is available through the VIEW master cards is the following topical outline for a dental technician.

What do you do?
What should you be like?
What training will prepare you?
How much money will you make?
What are the working conditions like?
Where in Utah will you work?
How many dental technicians are needed?
What are the steps of advancement up the career ladder?

The greatest advantage of the system centers around the creation of greater interest on the part of students who are reviewing occupational information, and around the fact that the occupational information can quickly, easily, and inexpensively be up-dated. The obvious disadvantage centers around the cost of such a program and the maintenance of the equipment.

Advisory committees have been formed which carefully examine the format and description of each of the occupational listings. The information and advice of the advisory committees have been instrumental in the design and revision of the master cards, and have stimulated ideas for a more effective and efficient presentation of the information.

We have solicited the help and cooperation of 15 schools within the state of Utah. Some of the schools have been designated as experimental schools, while others have been given the status of control schools. The schools represent urban, rural, rich, and poor settings. The 15 different schools will be given an assorted variety of equipment and information.

The evaluation of the effectiveness of the VIEW process will be done through interviews and questionnaires. An attempt will be made to determine if the students learned how to use the cards during the one-year experimental period, and if the information on the cards affected their selection of occupational goals. It is hoped that there will be a significant favorable difference between the students in the control schools and those who are in the experimental schools.

An Overview of Other Selected Vocational Education Projects in Utah

Utah is currently trying to better meet the vocational education needs of its rural youth. Consultants who have had experience in vocational guidance are being employed on a short-term basis to help design and develop four-year articulative high school vocational programs for the various individual rural districts. The programs are primarily being designed for grades 9-12. Besides helping with the overall design, the consultants are also helping to develop and outline some of the courses which are to be offered.

Extensive experimental work is also being done in attempting to provide vocational training for students from high schools which are too small to have adequate vocational programs. Thus far, the major emphasis in this area has been placed upon the utilization of Utah's area vocational school. "Favorable objectives" for five vocational areas have been established and three teachers in each of the five areas have been employed.

In order to improve the depth and breadth of the specialized knowledge of vocational counselors in the state of Utah, we annually employ several counselors for one month and place them in separate industries throughout the state. Upon returning from the work experience, a two-week workshop is held for the participating counselors. During that time, measurable objectives are developed, many of which lead to more realistic vocational counseling and improved course plans and tests.

I want to thank the Department of Vocational and Business Education of the University of Wyoming for the opportunity to speak to you this afternoon. Thank you.

RESEARCH AT THE LOCAL LEVEL TO SOLVE PROBLEMS IN VOCATIONAL EDUCATION

Gene Schrader

Director, New Mexico Research Coordinating Unit

State of New Mexico

Department of Education

Why should you, an administrator or a vocational educator, be interested in research? It is easy to imagine a teacher or administrator thinking: "We have a job to do--teaching the skills needed for occupational competency--so let's get on with it. Isn't most research just an academic exercise? And even if research is worthwhile, shouldn't it be left for the experts to worry about?"

More important to progress in vocational education than the establishment of specialized agencies of research is the development of a research attitude in every educator--from the state director to the local coordinator and teacher. There must be, on the part of everybody engaged in these fields, a clear recognition of the urgent need for educational research.

Vocational educators have been relatively tardy in becoming conscious of the importance of research. The cause of vocational education has been handicapped by complacency and failure to evaluate and study our own product. The small amount of research produced has largely been due to the developmental status of the field. Vocational education is one of the newest areas of the curriculum in the secondary schools. Leaders in vocational education have necessarily given their attention to promotional activities and to the development and extension of their programs rather than to research. The time has come when more attention must be devoted to thorough study and evaluation of existing programs, and to experimentation with new teaching techniques and administrative procedures.

Another limiting factor has been that relatively few persons in the field have possessed adequate competence in research procedures. This situation is gradually being improved as more and more young vocational educators with experience in research techniques enter the field.

In the third annual Phi Delta Kappa Symposium on Research, Dr. David L. Clark made the following statements concerning research in vocational education:

1. Personnel at all levels (teachers, board members, superintendents, principals) were very suspicious of other people's changes.

2. Professional articles and convention speeches were almost universally distrusted as sources of information.

3. Research reports had three liabilities:
    a. They did not deal with problems of concern to the practitioner.
    b. He did not understand them and consequently could not evaluate their significance.
    c. The practitioner distrusted the motives of the researchers.

4. The only really important method with a persuasive effect on the practitioner in initiating change was on the on-site visit to another school system where the change had been programmed and was in operation.

With the obvious distrust and change, it behooves the people in research to stress more research at the local level. By involving administrators and teachers in the planning and implementing of innovative practices, it will be possible to shorten the innovation to implementation time lag in education.

Vocational education can reap great benefits from research. The many unsolved problems in the field have retarded progress. There are controversial points which have led to confusion. Many courses from these fields have been built on opinion rather than fact because research was overlooked as an aid to improving instruction.

I have tried to lay a foundation for what I came up here to do; that is, talk about research in small schools. I see from the seminar roster that there are various sized schools represented so I will make my remarks general enough for all sized schools.

First, I wish to say that many of the topics for research I will mention have been borrowed from many of my Research Coordinating Unit colleagues. Some of these topics are mine, but many are not. I should like to suggest topics and problems and then have you help me design a proper setting for their solution.

1. Can we demonstrate the success of vocational education classes in high schools?
2. Do vocational classes contribute more or less to a student's success in college or the field of business?
3. Are children enrolled in vocational education classes of lower mental ability and/or lower socioeconomic status than their counterparts in academic areas?
4. Is there a relationship between what a pupil would like to take in his last four years in high school to what he actually does take? With this in mind, we could ask the questions: What does the pupil want to be? What does he think he may be? And what do his parents want him to be?
5. How can we keep dropouts in school and provide them with an opportunity to succeed?
6. Are we aware of what happens to our high school graduates? Where do they go? What do they do? Are they successful in their endeavors? What could we do to help them?
7. Is a class size of 25 for all conditions?
8. Is 55 minutes a day, 5 days a week the optimum amount of time for the learning process?
9. Is a sequential transition from kindergarten to first grade, first grade to second grade, and so on to grade 12 the best sequence for our youth? Why not third grade reading, fifth grade mathematics, fourth grade social studies for a student capable of such an arrangement?
10. The mathematical needs of an engineer, medical doctor, nurse, and members of the professions are well known. What are the mathematical needs of the persons employed in the less technical occupations?
11. What procedures and standards are appropriate for the selection of students' vocational courses?

12. What are the philosophical, economic, psychological, and social bases for vocational and practical arts courses?

13. How can more adequate related instructional materials be prepared and utilized in the several fields of vocational education?

14. How can follow-up studies of graduates make the greatest contribution to the program?

15. Which learning activities have the most value in the preparation for occupations? (Experimental work needs to be done to discover the merits of the exercise versus the project, the pseudo project versus real jobs, cooperative educational programs versus institutional, laboratory experiments versus work on real equipment, and demonstration versus supervised experimentation).

16. What has been the impact upon vocational education of the rapid technological changes occuring in industry. (What training is needed for new types of occupations? What new supervisory training is necessary? What new content should courses include?)

17. How can training centers for adult workers be extended and improved?

18. How can the education of guidance personnel be improved to include more experience and knowledge of occupations?

19. What is the relationship between organizational structure and the effectiveness of a vocational education or practical arts program?

20. How can educational programs and courses for vocational teachers be improved?

21. How can the special needs of individuals such as the handicapped, the unemployed, the slow learner, and the dropout be met most effectively in programs of vocational education?

22. What are the common elements in the various fields of vocational education and what do these imply concerning cooperative efforts in the future?

23. How do we measure attitudes of different publics towards vocational education?

24. How do we change or influence attitudes toward vocational education?

25. How do we identify and train a competent vocational education researcher?

The Indiana Research Coordinating Unit lists several research needs:

1. Analysis of changing and emerging skilled, technical, and other non-professional or sub-professional occupations;

2. Identification of newly developing occupations and fast-changing occupations requiring frequent examination of curricula;
3. Design or redesign of occupations based on a critical examination of a functional job field;
4. Occupational research oriented to vocational and technical education;
5. Comparative studies of different methods of occupational skill development;
6. The analysis and projection of employment, economic, and demographic trends;
7. Use and interpretation of occupational projections;
8. Follow-up studies of vocational-technical education graduates and dropouts;
9. Transferability of skills and knowledge in the labor market;
10. Analysis of costs, returns, and other benefits attributable to vocational-technical education;
11. Communications research relating to vocational curriculum development;
12. Effects of attitudes and emotional states on the perception, understanding, and retention of occupational information;

Many groups have established priority areas of research needed in education. In Georgia the Research Coordinating Unit conducted a conference to establish a priority list in vocational education. Portions of the list of priorities are listed below.

I. Home Economics

   A. A determination of the skills needed in related home economics research problems:
      1. hotel and motel service personnel
      2. food service workers
      3. drapery and slipcover makers
      4. altering and custom tailoring workers
      5. child care workers

   B. Investigation of the characteristics, both technical and non-technical, which employers desire in home economics--related occupation workers regarding age and sex

C. Development of evaluation techniques for
    1. post-high school and high school
    2. occupational education programs
    3. high school homemaking programs
    4. adult homemaking programs

II. Agricultural Education

A. A determination of the specific occupations requiring agricultural competencies

B. A determination of whether or not these competencies are needed in specifically agriculture or in agriculture-related areas of other vocational education programs with agriculture

C. Identification of a means of coordinating the related areas of other vocational education programs with agriculture

D. Identification or procedures to be used in determining needed agriculture training programs in a specific geographical area

E. A study of the results of team teaching method in the field of non-farm agricultural occupations

III. Trade and Industrial Education

A. Study of the feasibility of utilizing academic teachers for related basic courses in trade and industrial education

B. A determination of whether or not academic courses should be included in occupational training programs

C. A study of the effectiveness of team teaching in vocational education programs

D. A study into the feasibility of reducing the program length in some vocational programs from an 18-month period to a 10- or 12-month period, depending on the design, the objectives, and the student competencies related to these programs

E. A determination of practical and tangible methods of introducing study of "The World of Work" into public school programs

IV. Distributive Education

A. Identification of jobs in business and industry which presently rely on distributive services and identification of such jobs likely to develop in the future

B. A study of employment needs of business and industry which rely on distributive services

C. Development of a means to inform high school guidance counselors of current, practical, and accurate information concerning the world of work and job opportunities they must know about to accurately guide high school students

D. A study of effective methods of disseminating occupational information in meaningful classroom experience

E. A study to find a means of recruiting more well-qualified distributive education teachers who have developed technical abilities and methods of presenting technical information in meaningful classroom experience

F. A study to develop joint vocational education programs such as distributive education, home economics, and agricultural distributive education

G. A study to determine how to financially support the equipping of distributive education classrooms with laboratories

V. Business

A. A study of office duties and responsibilities in new and emerging occupations

B. A study to determine the optimum time needed for teaching required skills and insights for initial office employment

C. A study to determine the effectiveness of school placement and follow-up programs for graduates who entered office occupations

D. A study to determine the effect of work experience in the preparation of office employment

E. A determination of the effectiveness of methods used in the guidance and selection of students for vocational training programs in office occupations

F. A study to determine the effectiveness of funded training programs for the preparation of 16-21-year olds for entry into office occupations compared with similar programs in comprehensive public secondary schools

Granted that research is vital to our nations's prosperity and progress, granted that vocational education would be strengthened if policies were based on the solid foundation of statistical studies and experimental research, you may still be asking yourself these questions: Why should I be concerned with research? Shouldn't it be left to the experts?

The experts should be doing more research than they are currently doing, but research in our field will not progress very far without the cooperation of every teacher, coordinator, supervisor, and administrator engaged in vocational education. Research cannot be left to the few specialists on the staff of the state departments of education, or to the professors in the state teacher education institutions.

It is _your_ responsibility. Research in our field will prosper when each member of the profession considers it his own professional and personal responsibility and privilege to engage in research and experimentation, promote research activity, and use the findings of research in his everyday work.

RESEARCH, DEVELOPMENTAL-PILOT, AND TRAINING PROJECTS IN THE FIELD OF VOCATIONAL HOME ECONOMICS EDUCATION*

Vocational home economics education programs today are being influenced by the dynamics of change probably to a greater degree than almost any other aspect of the educational program. The following are some of the reasons for the dynamic changes which are taking place:

1. The changing roles of women require that more women are expected to be able to manage their homes effectively and see that the needs of family members are satisfactorily met. They are also expected to fill a full-time job outside the home, at various periods in their life cycle.
2. Needed services for the home and community, which utilize the knowledge and skills in the field of home economics, are rapidly expanding. Child care services, care and companionship for the elderly, food services of all kinds, services needed for the care of clothing, and the management and care of the home. Together with the expansion of these services, an increasing variety of related occupations, which require training, are becoming available.
3. The efforts of our government to break the cycle of poverty, and to help all people raise their standards of living so that they may contribute to the fullest and also share in the rewards of our society, have focused to a great degree upon raising educational and vocational attainments. The improvement of home and family living has been one of the main points of attack.

An increasing number of research, developmental-pilot, and training projects in home economics education, supported from vocational funds, are supplying a sound basis for direction for program planning and development in an effort to meet the changing needs of our society. Much more research and development is needed, however, not only in education, but in the supporting areas of study, to provide additional needed guidelines. The following is a brief summary of projects completed, or in progress, with the identification of other problem areas needing study and experimentation.

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*Compliments of the Wyoming Research Coordinating Unit, State of Wyoming, Department of Education.

Curriculum Development and Organization

The need for preparation for the homemaker role was revealed in the study: "The Interrelationship Between Home Environment and Employability," which was conducted at Iowa State University. At the University of Illinois, knowledges important for mothers to know about child development, and for child care workers, have been identified. Such studies help to provide important information for curriculum building, but more is needed as a basis for determining the objectives and basic learnings essential for a curriculum which prepares for the dual role of homemaker and wage earner. Placement of courses in relation to the "teachable moment," how to teach for most efficient learning, and the relationship between courses which prepare for homemaking and wage-earning all need study. The work on the psycho-motor domain of educational objectives, which was initiated at the University of Illinois, needs to be continued.

Preparation for wage-earning occupations utilizing home economics knowledge and skills to provide service for families and community has been the focus of a number of projects. Knowledge and skills needed for clusters of food service and child care occupations are being identified at Washington State University. Developmental pilot programs for preparing workers in the food services, child care services, and clothing services are underway at Oklahoma State University, Cornell University, and Michigan State University, under the support of 4 (c) funds, while others are being supported by state funds. A survey of curriculum materials needed in the food service area is being made by the Hotel, Restaurant, and Institutional Education Council. A study of attitudes toward food service jobs, an analysis of these various jobs, and a pilot program in the food service field is underway at Iowa State University. The identification of the concepts important for the orientation of youth to the world of work is developing at the University of Oklahoma.

Home economics programs for the disadvantaged have been the focus of several projects. An instrument to measure feelings of anomie among adolescents is being developed at Cornell University. Another study to measure social readiness for employment is underway at California State College at Long Beach. Factors which influence disadvantaged boys to stay in school, including family influences, are being studied at Florida State University. A conference was held last summer at Pennsylvania State University on the subject: "Home Economics Program Development for Disadvantaged Youth and Their Families." A follow-up study to demonstrate the value of an experience with the life and work of the disadvantaged, in the preparation of home economics teachers, is now underway at that institution. A pilot program to identify and overcome the gaps in the background of home economics leaders for working with the disadvantaged is being carried out at the University of Missouri.

Other problem areas needing study include: programs to help dropout girls overcome resulting handicaps; effective interrelationships between school and social agencies in helping disadvantaged families; education for parenthood of disadvantaged youth as a way of preventing such problems as we are now facing through the Headstart program.

Teaching Methods and Materials

A film is being developed by the Mental Health Film Board for recruiting and training women to become homemaker-home-health aides. Slides to illustrate the most important tasks in food service are being made and tested at Kansas State University. Programmed instruction in home economics is the focus of study at the University of North Carolina at Greensboro, with two different visual aids being developed for teaching consumer buying to Puerto Rican women at New York

University. Additional research and development is needed to provide a variety of audio-visual and other materials to support new developments in curriculum in the area of home economics education.

Teacher Education

Workshops for home economics teachers and leaders for developing and offering programs which prepare for wage-earning have been, or are being offered, at Oklahoma State University, Texas Technological College, Southern Illinois University, Michigan State University, Louisiana State University, and the Universities of Georgia, Kentucky, and Nebraska. These programs have focused on different aspects of the program. An experimental study to evaluate the effectiveness of a group counseling program maximizing the potential of home economics teachers is being carried out at Pennsylvania State University. At the University of Nebraska, a seminar to identify the structure of knowledge for home economics education courses on the graduate level is now being offered. Further research is needed to delineate differences, if any, in the preparation needed by home economics teachers who teach courses which prepare for homemaking and/or wage-earning; to identify the contribution which work experiences may make to teacher preparation; to the development of criterion measures for proficiency; and to develop guidelines for the possible use of a teaching team, of perhaps a teacher, an aide, and an expert in a particular occupational field in offering preparation for wage-earning.

Facilities and Equipment for Home Economics Programs

Little research or experimentation has been done to provide the basis for decision-making in selecting facilities and equipment needed for teaching home economics. This is particularly true in the wage-earning aspect of the program.

Evaluation

Follow-up studies of girls who enrolled in home economics classes while in high school have been done at the University of Arkansas and at Virginia Polytechnic Institute. These studies show very definite needs for girls to be educated for homemaking, as well as for employment outside the home. There is some evidence that education for homemaking contributes to effectiveness on the job, as well as in homemaking. At the same time, however, study in this area is needed. Research is needed to evaluate results, in terms of desired behaviors of individuals in the home and on the job, and in terms of community betterment, of programs in home economics education, and evaluation needs to be built into each innovative program in home economics education.

A CASE FOR AGRICULTURAL EDUCATION
IN THE PUBLIC SCHOOLS*

Agriculture is a basic industry.

All of us are dependent upon agriculture. An efficient agriculture makes possible our modern way of life. Only ten per cent of the population of the United States is required for farming. In Russia 45 per cent is required. In some other countries 80 to 90 per cent are engaged in farming.

Never were so many dependent upon so few for the necessities of life.

With only 10 per cent of the population supplying the food and fiber we require, it is essential that farmers be highly efficient. Modern, commercial farming is a large, complex, and competitive operation in which only the fit can survive. Our farmers require more general education and more specialized education for farming than farmers have ever before required.

Revolutionary changes in farming

No phase of American life is changing more rapidly or radically than farming. Among the changes having great impact are:

- Extensive use of machinery and automation
- Application to farming of research findings accumulated through a vast system of agricultural research agencies
- Migration of 2,000,000 a year from farm to city
- Enormous increases in the capital requirements for farming
- Rapid increase in part-time farming by persons who work part-time in other occupations
- Changes in the dietary habits of the American people which call for shifts in food production

Farmers require education continuing through their active careers

Because of continuing and accelerating change, farmers cannot depend wholly upon education acquired when they were young. Those who remain in farming are active, on the average, for 40 years. It is wasteful to society, and it may be disastrous to individual farmers, if the knowledge acquired by an annual expenditure of $250,000,000 for agricultural research is not disseminated and put to use. New interests must be developed and new attitudes and understandings are required, which are the products of education if the few farmers we have are to provide the increasing amounts of food and fiber demanded by an exploding population.

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*Compliments of the American Vocational Association, Inc., Washington, D. C.

Farm women need education in agriculture.

Although the nature of women's work on farms has shifted greatly, farm women need orientation to the science of agriculture and preparation for their special agricultural tasks. More than ever before, women participate in the basic decisions about farming. Many women, on and off the farms, own farm land. Many keep farm records. Where they have been allowed the opportunity, farm women want to participate with their husbands in classes in agriculture adapted to their common needs.

We have never had enough trained farmers.

Although vocational education in agriculture is provided generally over the country, there have never been enough young men entering farming after completing high school courses in vocational agriculture to replace the farm operators who leave farming. A high percentage of those who have been enrolled in high school courses in vocational agriculture have not received the education in agriculture beyond the high school required in a rapidly changing agricultural situation.

Agriculture is more than farming.

It is estimated that 40 per cent of the gainfully employed in the United States are engaged in occupations directly associated with agriculture. A large part of the costs of agricultural products is paid to those who serve consumers and farmers in growing, processing, transporting, and merchandising these products.

Agriculture offers many occupational opportunities.

A large segment of our population has found its best occupational opportunities in agriculture. In addition to employment opportunities in many types of farming, there are four other kinds of agricultural occupations in which many workers are needed:

1. Agricultural Business: buying farm products; selling feeds, seeds, fertilizers, dairy products, and farm machinery; managing farmers' cooperatives
2. Agricultural Industry: food preservation and processing; manufacture of farm implements and supplies; preparation of fertilizers
3. Agricultural Professions: veterinary medicine; agricultural education; agricultural extension; agricultural journalism; agricultural banking; government service in the United States and other countries
4. Agricultural Services: repairing farm machinery; constructing and repairing farm buildings; assisting farmers in record-keeping and income-tax reporting; spraying farm crops

In all of these agricultural occupations some general knowledge of agriculture and some specialized preparation for a particular occupation is needed. For some of them college and graduate school education is required. Teachers of agriculture provide counsel regarding opportunities and requirements in these occupations and share with business and industrial teachers in providing specialized training for them.

Agriculture taught in public schools has met needs and evoked favorable responses.

The principal development of agricultural education in the public schools has occurred in this century. It was becoming well established in the communities and states when the national government began in 1917 to share in financing vocational education in agriculture. Repeatedly, during the past 43 years, the national government has reaffirmed its desire to encourage and extend this type of agricultural education. Even more initiative has been shown by the states and communities. Although they have been required to provide only one dollar for each dollar of national funds, they are now supplying approximately four dollars for each national dollar. In addition, they are furnishing, from their own funds, all buildings, equipment, and teaching aids used in agricultural education.

Enrollments in programs partially financed by the national government have grown to approximately 750,000 annually. About 40 per cent of the enrollees are beyond high school age.

In addition, the public schools have served hundreds of thousands through their war-training programs in agriculture during World War II and their programs for farm veterans of World War II and the Korean Conflict.

Many schools conduct all or a part of their programs of agricultural education without national assistance. Much agriculture is taught in the elementary schools, in nonagricultural courses in the high schools, and in junior colleges, using only local and state funds.

All need appropriate agricultural education.

Agriculture is a major sector of our economy upon which all are dependent. It can be encouraged or destroyed by those outside agriculture. No other industry is more affected by public policy which all citizens share in making. All are consumers of agricultural products. Thousands of communities have agriculture as their economic base. Even our metropolitan areas have an important stake in agriculture. Large numbers of people who do not live on farms or in rural communities have interests, agricultural in nature.

Agriculture is taught in many ways.

Agriculture is taught in elementary schools, junior high schools, senior high schools, junior colleges, and the adult divisions of school systems. It is included in courses in the elementary and secondary schools taught under other names and in courses named "agriculture," offered in junior and senior high schools which continue for six weeks to a year. More commonly, a three to four-year sequence in vocational agriculture is provided in the high schools. Classes for young and adult farmers vary even more widely as patterns are developed which are suited to the convenience of each local clientele.

A high percentage of high-school students of agriculture attend college.

The percentage of former students of high school vocational agriculture who attend college is much higher than the percentage of farm youth generally who attend. Teachers of agriculture are alert to discover and encourage boys with college potential. They point out the opportunities in agriculture which call for college preparation. They recognize that many boys who have been raised on farms cannot find satisfactory employment in farming and that the colleges can provide career opportunities for them.

The public school's contribution to agricultural education is unique.

Many agencies now provide information for farmers. Some are creating the attitudes and understandings necessary if this information is to be used intelligently. The public school stands almost alone, as an agency able to reach all sections of the population, devoted to organized, systematic, and thorough instruction, and committed to teaching the truth without self-interest.

Most farmers and most workers in agricultural education other than farming get most of their formal education through the public schools. They cannot be considered well educated unless they have been educated for their special fields of work.

Farm surpluses should not deter us from providing needed agricultural education.

Agricultural education was introduced into the schools at a time when it was feared that we should not be able to feed our expanding urban population. It is partly to the credit of public school education in agriculture that we now have surpluses of some commodities rather than a general shortage of food. Weakening of our provisions for agricultural education might quickly change surpluses into shortages and greatly increase food costs.

Our surpluses constitute only about 2 per cent of our total, annual agricultural production. They are to be found in only a few commodities. They are by-products of the agricultural revolution which has made it possible for us to be the best fed, clothed, and housed nation that has ever existed. Little change would be necessary, in view of the rapid increase of our population, to make ours a nation with a food deficit.

Farmers need aid in adjusting to the agricultural revolution.

The drastic changes taking place in agriculture are dramatized by the movement of two million farm people, each year for the past ten years, from country to city. Farm youth need guidance in making the transition from country to city, if migration is required. Adults who can remain on farms, who are accustomed to farming and unprepared for any other occupation, need help in adjusting to change.

Education is the means accepted in this country for helping people to help themselves. If more had been spent on the education of farmers and their children, it would have been possible to reduce other expenditures made to help farm people adapt to revolutionary changes.

Our teachers of agriculture are a great asset.

A corps of more than 10,000 teachers of agriculture has been developed in the country. They are a special breed of teachers, recognized for their practicality, their high interest in their students, their concern with community as well as children and youth, and their dedication to their work. Their talents must be used advantageously and more of their kind must be added. There is no question about the status of agricultural education in a school system where a capable teacher of agriculture is at work.

We have only begun to provide agricultural education in our schools.

It is sometimes conceived that we once had the right amount of agricultural education in our schools and that, with a decline in the percentage of the population engaged in farming, the amount can be reduced. Actually, we have only begun to develop agricultural education as a function of the public schools. Many who should receive it have not been reached at all. Our provisions for agricultural education beyond the high school have always been most inadequate. It could not have been expected that a full and complete program of agricultural education could be developed in a few decades. Many schools did not begin teaching agriculture until the last decade. A third of the agricultural communities of the nation do not yet provide it. Little agricultural education has been made available in communities that are not primarily agricultural.

Agricultural education is being modernized.

No one should conceive modern agricultural education to be the same as the agricultural education he experienced a generation ago. Facilities have been greatly improved. Teachers are better prepared. New types of subject-matter, required in modern agriculture, have been added. Teachers are giving more attention to their counseling function. Most schools teach adults as well as children and youth.

What of the future?

Agricultural education has become an integral and established part of American public education. The American example is being followed in many other countries.

Its future in the United States is indicated by the large investments which have been made in new buildings and other new facilities during the past 15 years, almost uniformly over the country.

Agricultural education in the public schools has the strong support of farmers and the public, who have come to expect that it will be provided and that it will be continuously improved.

Some schools that once taught agriculture have been consolidated in new districts so that in some parts of the country the number of schools teaching agriculture has been reduced. The teaching of agriculture has been discontinued in some districts that have become urbanized, where it is assumed that agricultural education is only for farmers and prospective farmers; in some school systems too small, weak, and poorly financed to support any kind of education adequately; and in a few districts where teachers have been inadequate for their tasks.

However, losses of these types have been offset consistently by gains elsewhere. Enrollments in vocational agriculture in the United States have remained almost constant during the past ten years.

Agricultural educators and the public are more inclined than they have been for a generation to look at the program of agricultural education the schools are offering and to revise them in terms of current and prospective needs. It may be anticipated that, as concepts of public school education in agriculture are revised, as a broader clientele for agricultural education is recognized, and as changes are introduced in keeping with the sweeping changes in agriculture, enrollments will again rise.

We may be sure that this form of public education will continue and we may anticipate developments in it during the next 50 years which will overshadow those of the past 50 years, the period in which public school education in agriculture was being brought into the American educational scene.

NEW DEVELOPMENTS AND THEIR IMPACTS ON TRADE AND INDUSTRIAL EDUCATION*

The new developments in Industrial and Practical Arts Education seem to be more comparable to building and strengthening the flesh and blood around a good sound, solid and adequate skeleton of framework than in developing something entirely new. In other words, little, if anything, has happened since 1918 that creates a demand for a sound instructional program in Industrial and Practical Arts Education that cannot be done effectively within the framework and structure of the existing programs, laws and policies.

The new developments that have come about and are even now in process have had and are having considerable implications for and impact upon Industrial and Practical Arts Education. These have to do with some changes in the programs as well as changes in the relative importance of these areas of education. Some of these new developments and their implications are treated in the following paragraphs.

The Shift From an Agrarian Economy Toward an Industrial Economy

Perhaps no nation was ever known to move so rapidly from rural to urban living and from agricultural to industrial employment as has the United States of America within the last 30 years, and particularly within the last 15 years. Many things have contributed to this trend. One of the chief causes has been the shift to mechanized and scientific agriculture. This shift has resulted in greater agricultural production with tremendously less proportionate man-power requirements in agriculture. This has reduced greatly the percentage of the total population that can find suitable economic opportunities in agriculture. Of course, this has also magnified greatly the importance of Vocational Agriculture Education for those who remain in agriculture. However, from the standpoint of numbers needing Vocational Education the shift has been definitely toward those preparing for employment in areas served by Trade and Industrial Education.

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*Compliments of the American Vocational Association, Inc., Washington, D. C.

A second factor has been the increased standard of living of the American people. This, of course, has created greater demands for goods and services which in turn have created job opportunities in occupations for which Trade and Industrial Education offers training.

A third factor has been our steady, and more recently, rapid population growth, most of which is centered in urban areas. This, too, has greatly stepped up the demands for goods and services. There are other factors but these seem to be the major ones.

All available predictions of future man-power needs made by the best known authorities on the subject indicate the continuation of these trends at an even more rapid rate in the years ahead.

The Rapidly Increasing Scientific and Technological Advances Being Made in Industry.

It has been said that more change and progress in science and technology have been made in the last half century than in all the ages past. The industrial workers and the tradesmen of today have to know, and be able to apply to the work of their occupations vastly more mathematics, science, and technology than in years past. They must use tools, instruments, machines, and devices that did not exist 25 years ago. They must work with materials using methods and techniques which similar workers of a few years ago had never seen or known. They must work to tolerances that the older craftsmen would not have believed possible. All of these facts, and many others, point to the necessity for even greater stress upon the necessity for increasing amounts of related technical information being included in the courses to prepare workers in trade, industrial and technical occupations. It has even greater implications for expansion and improvement of extension courses for employed workers to keep them abreast of rapid technological and scientific developments as they relate to their occupations.

The Increasing Contributions of Scientists and Engineers to Industrial Materials and Production

Much of the great industrial progress made in the last half century can be attributed, in part, to the contributions of science and engineering. Progress in the future will rest even more heavily upon scientists and engineers who will plan and design different and better ways of using our present known materials and knowledge. They will explore, experiment, and discover new materials, and new uses for presently known materials. As scientists and engineers become more and more vital and necessary to progress in this scientific and mechanical age they must be relieved from the necessity of performing chores on less than scientific and engineering levels. To make this possible there seems to have appeared in the nation's work force a new kind of worker.

This type of employee is being referred to by some people as a "technician." However, this term does not fully describe the responsibility in the form of skill and technical knowledge required by the employee. His education and preparation for his work will differ from that of the craftsman as well as from that of the scientist or engineer. However, since he must be associated with both these groups in the performance of their duties, consequently he must use the language of the scientist or engineer, and also must have an understanding of a craftsman's skill in handling tools, machines, and materials. His technical and scientific knowledge must extend beyond that of most craftsmen. Furthermore, his knowledge of machines, tools, and processes of production must be greater than that of the scientist or engineer.

The great and growing need for this type of personnel can be, and is being, met most quickly by the careful selection of the more able tradesmen who can secure this training through extension courses in technical education. The training of these people has caused, and is still causing, considerable confusion in the minds of many educators. Some educators seem to feel that technical education is simply a part of engineering education. They take the position that those who "drop out" of engineering programs after two or more years are the persons to be trained for these technical positions. It is true, however, that a number of these people are employed by industry and become technical assistants. Other educators feel that technical education can be acquired only in Junior Colleges and technical institutes through terminal courses on a post high school level.

Most vocational educators see varying levels of technical jobs. They agree that some levels and kinds of technical training can best be developed through the Junior College or Technical Institute type program. There are other levels and kinds that can best be developed through upgrading capable craftsmen and/or building the technical program on top of or in conjunction with a modification of trade preparatory programs at either the high-school or post high-school level. As these people take their places in our industrial economy their roles will become more clearly defined. Then, and only then, will it be possible for educators really to know which workers can be best prepared and where that preparation can be obtained.

The appearance of these new technically trained men will necessitate considerable adjustments in Trade and Industrial Education programs. It broadens, extends, and elevates the scope of Trade and Industrial Education. It brings with it some dangers. It could conceivably move along an academic collegiate path rather than a vocational one. It could minimize present good trade and industrial education by an attempt to combine the two or to replace the one with the other. As is generally true, this new development brings great challenges and with those challenges some dangers. It will be the alert vocational educators who will keep a proper perspective and not go overboard in trying to make all trade preparatory, cooperative and extension programs technical in nature.

The Growth in Size of Industries and the Numbers of Workers Engaged in Like or Similar Work in More Compact Areas Has Vastly Increased the Problems of Personnel Relations and Managements.

It is no longer adequate just to have a sufficient number of well-qualified craftsmen in an industrial plant or organization. There must also be people with the necessary skills and knowledge to manage men, machines, and materials to get efficiency of production. The management of personnel has become quite rapidly a matter of leadership and persuasion rather than of force as was the case a few years ago. This noticeable trend has implications for even greater emphasis upon education and training for industrial leaders.

The Increase of Automation and Line and Mass Production

These and other developments have had a tendency to create the operator type of workers and other workers whose jobs are rather narrow in scope. Considerably shorter periods of time are required to train such workers than to train people in "whole occupations." This will probably place emphasis upon the short unit intensive types of courses in Trade and Industrial Education known as the Type C Trade Preparatory Program.

Industry Seems to be Engaged in the "Double Barreled" Process of Raising the Entrance Age and Educational Levels for Young Workers.

This trend has already resulted in much discussion and some action concerning vocational education on a post high school basis. Should there be a continuing trend to raise the entrance ages and educational levels of young workers, a very natural result would be to extend the secondary school periods into the 13th and 14th years with probable emphasis upon vocational preparation in the last two years.

Russia's Initial Prowess in Rocketry Aroused the American Public and Brought About an Inclination Toward Over-Emphasis Upon Advanced Academic Science and Mathematics for all High School Students.

This trend toward greater emphasis in these areas coupled with recent Federal legislation to subsidize these areas has created no new problem, but it has reemphasized a problem of longstanding. Throughout the country, with a few shining exceptions, there has always existed a lack of understanding of Vocational Education on the part of general school people which resulted in using vocational education classes as a dumping ground for those students who lacked ability. Recent events which have put in the spotlight the areas of mathematics and science have caused an alarming number of good solid American citizens to overlook a few very important facts. Some of them are:

(1) A very small percentage of all the people will ever work or live in any situation in which advanced academic knowledge of mathematics and/or science will be of any material value or importance.

(2) Relatively few people have the kind or amount of intelligence to profit materially from advanced abstract academic knowledge.

(3) Most all people can master and profit by the subject matter, regardless of how advanced, if it is taught in its applications to activities in which they are interested and engaged.

(4) Most trade, technical and other occupational courses include, and require, the mastery of, and ability to apply much more mathematics and science than most educators and lay persons realize.

The years ahead will require increased efforts on the part of vocational educators in selling and keeping vocational education before the people in its true lights and for its intrinsic true worth.

The Population of America Becomes More Mobile Year by Year

Improved highways, easy credit, better automobiles, aeroplane and bus transportation all contribute to the mobility of the population. This increasing mobility of the work force points up the necessity for a greater degree of uniformity in education and training for trade, industrial and technical jobs. The auto mechanic of California today may be an auto mechanic of Florida tomorrow. This has somewhat centered attention upon the development of instructional materials on a coordinated basis nationally and particularly on a regional or subregional basis.

High Schools are Moving Toward a Six One-hour Period Day

This trend has created scheduling difficulties for Trade and Industrial Education. It has practically eliminated the more preferable Type A Trade Preparatory Programs from the comprehensive high school and has added to the difficulty in scheduling for the Type B preparatory and the cooperative type programs. Some vocational programs in some states have gone to the one-hour period program. However, most states maintain the standards that more nearly insure an adequate instructional program.

Trends in Vocational Technical School Organization

Some states are developing separate vocational-technical schools; others are developing vocational-technical education comprehensive high schools and community colleges. In recent years a number of additional cities and states have found that they can best serve the vocational training needs through separate vocational schools. In some states the vocational training needs can best be served through the comprehensive high schools and junior colleges. Each state will need to determine how--under its educational philosophy--it should organize and conduct its program of vocational-technical education.

During the Last 20 Years There Has Been a Tremendous Growth in the Programs of Diversified Cooperative Training in Secondary Schools.

This trend is perhaps more noticeable in the southern states and is probably due in part to the lack of educational funds in those states with which to build, equip, and staff adequate school shops to do effective programs of preparatory training. However, experience has shown that cooperative training is not only less expensive, but if properly conducted, it actually compares favorably in all respects with preparatory training. It has a much higher degree of flexibility. Effective training can be given to a single student in a single occupation. Training in any occupation can be discontinued without loss or inconvenience to any one when the need has been met; it can be started with little or no expense for certain occupations through the cooperative program that could not be offered reasonably in a school trade shop--a greater variety of courses can be offered. The training is always up-to-date because it is done in industry on actual production jobs under the instruction of craftsmen who presently earn their living working at the occupations they teach.

There Seems to be Mounting Interest in the Junior or Community College Development.

This growing interest ties into the extension of secondary education to the 13th and 14th years. Several states have moved quite rapidly in this direction. Some impetus is given this movement by the fact that some of the more widely known American colleges and universities are publicizing the fact that they are unable to accommodate all who apply and meet entrance requirements. However, some authorities point out that many good public and private colleges and universities that are perhaps less well known but quite reputable still have room for many additional students.

In many instances junior or community colleges offer terminal vocational courses only. Others offer both terminal courses and the first two years that lead toward a baccalaureate degree, while still others offer no terminal courses but concentrate upon the freshman and sophomore year subjects of the baccalaureate degree program. The general tendency has been for the latter two kinds to strive toward becoming full four-year colleges and eventually to abandon terminal courses. The increasing number of so-called technical institutes is closely akin to the first and second types indicated above.

The one cause for concern with the development of junior and community colleges so far as vocational education is concerned is that the central purpose of vocational education (to fit people for useful and profitable employment) may be ignored or relegated to minor importance. This can be avoided but only if due care is exercised to prevent it.

The Growth of the Number of Labor Groups Establishing Educational Funds

In recent years there has been a noticeable increase in the number of examples of labor groups that are assessing the worker and his employer a few cents per hour worked to build up "educational funds" with which the organizations operate educational programs for their members. Over a long period this has dangerous implications for our American system of public vocational education. This could lead eventually to placing public vocational education upon such a delicate balance that it could be easily tipped in the direction which prevails in many European countries whereby all such education would come under the jurisdiction and administration of the Department of Labor instead of Education.

This tendency of unions to build up funds for education probably stems in part from the inability of vocational education to serve fully their needs for education. Most often this inability is due to lack of funds. In some cases it is due to policies peculiar to a few states. In other cases it is due to the failure of education to make known to labor groups the services that are available to them. Those who have studied the matter most closely are of the opinion that vocational educators should strive to bring about relationships such that labor organizations would see the distinct advantages of using their financial resources to assist public vocational educators to render the services needed, in lieu of duplicating or operating in competition with them.

Most of the trends and new developments discussed here have parallel implications for the practical arts also. This ever increasing scientific, mechanical and technological age places the spot-light upon the importance of general education including greatly expanded and extended programs of industrial arts. As a part of everyday living in the home and community, people today as never before need a better understanding of and appreciation for the arts and materials of industry. The rapid development and expansions of office work necessary in modern day business and industry as well as drastic changes being made places the spotlight upon expanded and improved training of all types of office workers.

The purpose of this bulletin is to impress upon our educators the very important role they should play in the educational and industrial developments of our country. If America hopes to retain its present industrial supremacy, it is necessary to improve and expand our vocational and technical educational programs to cope with the international competition of the immediate future.

THE FUTURE OF COMPUTERS IN EDUCATION*

James Hummel

Educational Computer Specialist

Fabri-Tek Incorporated

Edina, Minnesota

Many thousands of computer systems are presently in use, and thousands more are being planned for in the years to come. Computers will affect the lives of every human being in some manner. There is no doubt that the future belongs to those who understand the device and, to a great extent, the nation's future progress depends upon putting it to work in the solving of our social, industrial, scientific, military, and educational problems.

Computer dynamics must be taught to large numbers of people and it is imperative that we realize that the main responsibility for computer education of the population-at-large will fall primarily upon the nation's educators and educational institutions starting at the elementary and secondary school level.

The majority of students should have an opportunity to study firsthand the basics of computers and analyze problems which can be solved by them. This opportunity should be provided, if for no other reason than to foster student understanding of the computer-oriented society confronting them. It is not necessary to limit use or study of a computer to only a selected few students in certain curriculum areas.

An important emphasis in today's education is to give the student an understanding in subjects that will prepare him for further study, or will prepare him for situations outside the classroom. Is not the study of the basics of a computer therefore essential prior to advanced study? Is not the study of computers as important, or more important, than driver training, typing, office machines, dancing, and the like?

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*Reprinted from "Computer Bits," June, 1967.

Another important emphasis in today's education is to give the student an understanding of each process he performs or studies. Upon gaining this understanding, the student is well equipped to logically attack the next problem confronting him. The large scale computer with its complex problem-solving capacity cannot in itself adequately provide this understanding. This full scale computer is necessary but only after the student gains a full understanding of what a computer is, what it does, and how it performs its operations. Let's take the mystery away from this device. Upon learning the basics of computers, problem solving is the next step toward use of the full scale computer. Here time sharing becomes a means. However, there should first be the completion of the basic understanding, then the full scale computer provides a means by which the interested student can more fully explore a device no longer surrounded by a cloud of mystery.

There are many proponents today for teaching computer languages, such as FORTRAN. They visualize and even recommend large cooperative computers, or transporting students to computer centers. Is this not like teaching a student how to write a short story before you teach him the fundamentals of the English language? Is this not like teaching someone how to use a slide-rule before teaching him the principles involved, simply because it's more convenient? And who is to say that today's languages will be the languages of tomorrow. Why not start at the beginning. What is a computer? What makes a computer perform the way it does?

As emphasized above, computer study should not be limited to a selected few. The average and below average student must be given an overview of computers, and actually have an opportunity to work with them. It has been shown that computer training has great possibilities in the area of reducing dropouts. The opportunity for the potential drop-out to actually train on and operate a computer has tremendous motivational effects. Exclusive use of the large full scale computer does not give students this essential "hands-on" time.

Fortunately many vocational, trade, and higher educational institutions are entering the area of computer education. The introduction, however, should be in the elementary and secondary school level.

3R + R = INNOVATION*

George R. Kuhn

Northwestern Michigan College

The Three R's

This country of ours, the United States of America, is a world leader in many endeavors, not the least of which is in the field of education. The United States as a country adheres to a philosophy that everyone should be educated, that is, all young people should attend school, with opportunities for adults to return to school. Democracy can only operate in an educated society. But just what are the goals of education, why should all young be sent to school, and what should they be taught? Certainly education should teach the students to react rationally with their environment: the student should learn how to control his environment and not be controlled by it. The student, in addition to these general goals, must be taught to earn a living. Fundamental to all of these goals, as every school administrator recognizes, is the need to teach the three R's of reading, writing and arithmetic. These three subjects underlie and form the foundation for all education and certainly, for the fulfillment of the goals of education, enable the student to interact rationally with his environment. A fundamental of education, and this is indicated by the word rational, is to teach the student to think. However, no special effort is made during the student's entire school career to teach him how to think. Reasoning is taught only by example. An arithmetic class, or reading class, or writing class is aimed specifically to teach a particular subject matter, that of arithmetic, for example. The idea of thinking logically is only brought in as a secondary effect of the standard courses in the curriculum.

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*Reprinted from "Computer Bits," June, 1967.

By lecture and reading the processes by which valid conclusions are arrived at are demonstrated to the student. This is true in every subject that he might take: history, for example, certainly looks for the rational causes. It is also true in business and language courses. However, no very special effort is made to teach the student to think, to analyze a problem, to break it down into logical steps, to follow the steps and arrive at a valid conclusion. In order that a school graduate, or anyone who has been to school, whether or not he graduates, can be a productive citizen, that person must understand his environment and his government. In order that the student become a productive employee or entrepreneu it is necessary that the student develop certain traits or habits. One of the major characteristics desired by an employer of an employee is the ability of the employee to think for himself. But where in the school curriculum is this ability taught specifically? True the traditional courses in mathematics, algebra and geometry, have as one of their goals to teach the student to think logically. And it is certainly true as mentioned above that all instructors attempt throughout the duration of all courses to teach by demonstration the logical steps to problem solution.

The Fourth R

There is, then, a need for a fourth R to be added to the previous three. The fourth R is a course in reasoning. But how can reasoning be taught; how can a student be taught to look at a situation, decide how to dubdivide the situation into smaller parts, how to solve each of these parts, and ultimately to place these parts back together to give him a reaction or answer to the total situation. One such course that would do this would be a course in computer programming. The purpose of this computer programming course would not be to teach the student how to become a proficient programmer but to teach the student how to analyze and solve problems, how to interact with situations with the computer as a teaching tool. The course instead of being called computer programming would be called programming analysis to emphasize the fact that the purpose of the course is logical analysis.

The Computer and the Fourth R

How, then, could reasoning be taught using a computer? First of all, to program a computer it is not necessary to be a graduate mathematician or business administration student. To program a computer all that is required is the ability to resolve the problem into very detailed sequential steps, and by following the minute steps arrive at the solution. For example, how does one make change for one dollar. This problem is described by Bernard Gallerd in his book, The Language of the Computer. It is a problem that any 5th or 6th grader is familiar with, but yet have you ever tried to write down the steps to make the correct change? For example, if someone gives you a $5.00 bill to pay for a $1.74 item, almost by intuition you know that the change will be one penny, one quarter, and three one-dollar bills. But how did you arrive at the solution? And still more difficult, have you ever tried to instruct a five-year-old on the process of making change in general? This then, is not a problem just in arithmetic, but in reasoning also.

The Tutor and the Fourth R

One of the difficulties in teaching logical thinking, and this is probably why we teach many subjects by rote rather than reasoning today, is that a tutorial approach is required. Each student's approach to the problem, though logical, is probably slightly different from the solution of every other student. We cannot teach all students to reason in the same way. Each student will have his own peculiar problems with which he will be confronted in solving, for example, the change problem. How, then, can reasoning be introduced into the elementary or secondary education system?

The change problem as described above is a problem that can be solved on a digital computer. The problem could be analyzed, a method devised, a series of steps defined, the steps entered into a computer, and then the computer is allowed to follow the steps defined by the individual programmer and arrive at a conclusion. In this way the computer actually checks the logical steps devised by the student programmer. This is the same process by which an instructor would have to test the possible solution of any individual student. But the student/computer process has advantages over the student/instructor process. The computer being a machine will blindly follow any instructions given to it. The computer has no biases, no feelings, whereas, on the other hand, the instructor when confronted with examining a possible solution by a student will be guided by his own logical processes. The student's solution might very well be correct but if it differs from the solution devised by the instructor, the student's problem might be marked wrong. Hence, the computer without feelings, without emotion, without biases becomes an extremely good testing device for logical processing.

The Computer as Personal Tutor

The use of the computer allows the student to test his own problems without the pressures of the teacher or other individual looking over his shoulder. This concept of teaching reasoning by computer is simply another form of computer assisted instruction (CAI) or computer assisted learning (CAL). There is one variation in this process: in computer assisted instruction, the problem itself is programmed by a professional for the computer with all possible variations. The student then interacts with the computer as if he were interacting with the instructor. On the other hand, in teaching reasoning by a computer, the computer would begin as a blank to the student. The student would insert his own solution, his program, with the computer following the instructions given it and either giving a valid answer or invalid answer, thus testing the logical process as proposed by the student.

One major difference, and this is an important one, between the normal computer assisted instruction system and this learning situation, is the size of the computer required. For computer assisted instruction a large computer with massive memory would be required, but for the course in reasoning only a small computer is needed. Any small internally stored program computer would be satisfactory.

Currently on the market are a number of low-priced computers. Many schools could feasibly introduce such a system. Many already have. The cost of a satisfactory computer for a course in logic or reasoning practice ranges from $6,000 to $20,000. Hence, if a $10,000 computer were chosen for a school of 500 students, the per student cost would be $20.00 and certainly the per student hour cost would be down around the range of $.50 or $1.00 for equipment.

Computer assisted instruction in reasoning certainly is feasible and as the price of computers continues to decline and educators become more familiar with computers, a closer approach to the goal of education--to teach the student how to think--will be attained.

COMMUNICATION TECHNOLOGIES

Representatives of Mountain States Telephone Company,
Victor Electrowriter, Behavioral Research
Institute, and Others

Because the nature of the session centered around a series of demonstrations, this writer felt that a brief description of the proceedings and of the instruments used would best "cover" the session. The bulk of the information was derived from a Bell System brochure entitled: "Communications Extends Resources for Education." The following is a summary of the proceedings of the two-day "Communications Technologies" program.

Color film on telelecutre in education.

Telelecture by Dr. V. A. Ryan, Director, Oregon Research Coordinating Unit, Oregon State University, Corvallis, Oregon. Topic: "Needed Research in Vocational Technical Education."

Question and Answer Period with Dr. Ryan.

Telelecture by Elizabeth E. Hunt, Director, Technology for Children Project, State Department of Education, Trenton, New Jersey. Topic: "Technology for Children Project."

Question and answer period with Mrs. Hunt.

Telelecture-Telewriter Demonstration by Victor Electrowriter personnel from Chicago, Illinois.

Educational Television--Dr. Robert E. Bell, Coordinator of Educational T.V. for the University of Wyoming.

Learning Lab Access (Dial Retrieval).

Learning Lab Access. Retrieval of a French lesson from the University of Illinois.

Learning Lab Access. Retrieval of the inaugural speech given by John F. Kennedy. This speech is retrieved from an Educational Service Center in New York City.

Learning Lab Access. Retrieval of up-to-the minute happenings in Congress on various bills presented. This information retrieved from Washington Dial. Sponsored by the United States Chamber of Commerce, Washington, D. C.

Compressed Speech Techniques.

Information Retrieval
Retrieval of Research material, and live problem solving from computer at Cooperstown, New York. Teletypewriter will be the vehicle used for this demonstration.

Concept of Programmed Instruction, presented by Mr. D. J. Koza, District Manager, Behavioral Research Laboratories, Englewood, Colorado.

Telelecture on Programmed Instruction and Remedial Reading.

In the acquisition of knowledge, mankind is advancing so rapidly that two major problems are created. One is to find a method of storing information in the most practical form; the other to provide a means of rapid referral to any desired part of this information. Limitless extensions to library storage, with conventional methods of access to the proliferating multiplicity of books, journals and other printed papers, are not the ideal solution, certainly.

Most educators agree that the promise for the future--in libraries, in learning laboratories, and in the information banks that libraries are becoming--is the augmentation of conventional print by microfilm, micro-dots, magnetic tape, computers and the like. Information stored in this way can be retrieved by any student over any distance--by telephone or teletypewriter. Access will be speeded by the use of advanced techniques in classifying and indexing, machine translation and electronic scanning.

Depending upon the nature of the information the student desires, the form in which it is wanted, it may come back to him as a voice message out of a computer, a print-out on a teletypewriter, a slow-scan or regular TV image on a cathode ray tube, or a facsimile reproduction that may comprise many pages. Such techniques are bound to extend the horizons of knowledge virtually beyond limit, making it possible for students in even small, remotely located schools to have speedy access to centrally located reference material through the facilities of the telephone network.

Thanks to the vision and cooperation of the modern, creative educator, all these facilities and capabilities are available now to meet the challenges of the present and the opportunities of the future. The following items are some of the new concepts, systems, and services which are now ready to help meet the present and future needs of education:

Tele-lecture

Tele-lecture lets your class discuss important issues with distinguished people--authors, artists and specialists in various fields--over special loudspeaker equipment connected with regular telephone circuits. You can share in programming with other schools, and use resources which may be located anywhere. Your resource can speak from any ordinary telephone, over any distance, without need for any supplementary equipment. He may speak to one audience or to several, hundreds of miles apart. Communication is two-way, for students may question the lecturer, and he in turn may key his presentation to the interests and responses of the class. Nor need the lecture be confined to one speaker only: panel discussions can readily be arranged for several speakers, who may be in different parts of the country.

Telewriting

Telewriting, operating over Bell System Data-Phone* data communications service, makes it possible for a distant lecturer to supplement his telephone lecture (or TELE-LECTURE) with handwritten notes or drawings projected onto a screen in your classroom. Students can follow as he works out a mathematical problem, makes a synthesis or a dedication, shows the details of a construction, just as if they saw him in person. The notes and diagrams he makes at his desk are reproduced on a screen before your students as he writes. He may be lecturing from his study or a classroom, in which case his notes would also be projected for his own class. Thus the horizons of education are extended through the addition of a visual dimension to the basic Tele-Lecture concept.

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*Service Mark.

Television

Television is unique because it brings into the classroom the sight and sound of happenings that make history. For the student, this means that learning comes alive. Events happen before his eyes and their sounds ring in his ears as if he were present at the scene. Television reaches not merely into any one classroom; it can be used simultaneously in many schools as open broadcast, or the schools may be linked in a local, state or regional network. Costs are thus minimized and, through the use of video tape or film, lessons and special experiments can be repeated as often as desired. Thus lectures that might be too costly for a single showing in a single school can be amortized over a period of time.

Telephone Teaching

Telephone teaching can bring new and special benefits to children who, for one reason or other, cannot attend class in the regular way. At present, many communities have school-to-home telephone facilities which permit the individual disabled child to gain a great many benefits, much as though he were actually in class. But now, with the aid of Telephone Teaching, a qualified teacher will be able to give her full time and attention to a special class composed entirely of as many as thirty bedridden pupils or gifted children. The teacher will always be in control. A special console enables her to speak to all pupils at once, or with any one of them privately, and she will always know which pupil is speaking at any given time. The teacher can even release part of the class to do independent work whenever required by the demands of schedule or curriculum.

Learning Lab Access

Learning lab access means making recorded information available by telephone to groups of students on a scheduled basis around the clock. Libraries are now adding sound to their traditional resources of print. As many as thirty students may listen at the same time over their individual telephones to the replay of information in one subject. Other groups of up to thirty students each may dial in from their telephones to hear other lectures on other subjects at the same time. This system can be expanded to accommodate any number of groups and subjects. Learning labs can be used for linguistic programming as well as adding a new dimension of information through the spoken word.

Information Retrieval By Teletypewriter

Information retrieval by teletypewriter makes computer facilities and programs readily and economically available to students in many schools on a shared bases, over virtually any distance spanned by the telephone network. The teletypewriter can be used to feed data into the computer and interrogate it. It helps the computer to become an important tool for students from junior-high through professional schools, in any discipline in which the storage of large amounts of information and speedy, convenient retrieval are important factors. A teletypewriter can also be used for other administrative purposes--library information, attendance reports, supply and book purchasing, inventory control, facilities scheduling, tests and measurements, personnel programming, payroll and virtually all other administrative data that require quick, convenient and accurate handling.

THE TECHNOLOGY FOR CHILDREN PROJECT

Elizabeth E. Hunt

State Supervisor of Industrial Arts K-6

State of New Jersey

Department of Education

The purpose of the "Technology for Children Project" is to make it possible for children in grades K-6 to explore technical devices and engage in the fundamental processes by which man has created his technological world. These processes include ways of thinking about and dealing with the physical material world, the effectiveness of which is attested by the sophistication of contemporary technology. Further, all subject areas of the elementary school are inherent in a study of technology so that the tools, materials, and processes of technology can be exploited for a fuller, richer understanding of science, math, social studies, language arts, and other related areas.

The Vocational Division of the State Department of Education launched the "Technology for Children Project" through the "1966 Summer Institute of Technology for Children" held at the Helen L. Beeler School in Marlton, New Jersey. It accomplished the following goals: First, it demonstrated that even though the central focus on activity was on dealing with tools, materials, and technical devices, all of the areas of the curriculum emerged to be encountered by the children in a meaningful context.

For example, the following items were included in the literary work of children ages 4-8 as the result of a trip to see a bridge being constructed and a building being demolished with a steel ball.

Our Trip*

Big banging noises
The bulldozer pushing
Hammering
Steel coming up
Bumping
A motor starting
Dirt being pushed

The smell of the smoke
And the smell of the river
Cement and rock falling
Wires falling
A lock falling
The banging of the crane.

The other areas of the curriculum became equally manifest and were dealt with the children as documented by the anecdotal records taken during the institute.

Second, it initiated a developing expertise on the part of twenty-two elementary classroom teachers, who are now back in their own classrooms trying out similar activities with their children.

Third, it provided opportunities to test and evaluate what tools, materials and working surfaces would be adequate to carry on these activities in a classroom setting.

Fourth, it indicated to us how to draw upon local community resources, especially industries, for consultants, on-site construction projects, and plant visitations.

The basic effort in the "Technology for Children Project" will be directed toward developing elementary classroom teacher expertise in conducting technologically-oriented programs. This will call for more summer institutes of technology for children, in-service workshops, and pre-service preparation.

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*By the Primary Group

Title I monies have supported an in-service workshop for teachers in technology for children. It was conducted by Dr. Robert G. Thrower of Trenton State College at the Westampton Elementary School, Burlington County. Mr. Clarence Ridgeway, Principal of Westampton, submitted the proposal.

Six staff members will be added to the Vocational Division to serve with the "Technology for Children Project." These additional staff members will include both elementary classroom teachers and industrial arts teachers. As soon as they are hired, their services will augment the work of the 22 teachers who participated in the first summer institute of technology for children. In addition, they will initiate and sustain programs in other schools through in-service workshops. developing materials which can be used in the classroom, and providing technical assistance in planning classroom facilities. They will also be available to assist the teachers with instruction, where the content of the instruction is of a technical nature.

If one is interested in having this kind of program developed at the K-6 level in his school, he is invited to contact Elizabeth E. Hunt, Supervisor of Industrial Arts K-6, Vocational Division, New Jersey State Department of Education, Trenton, New Jersey, 08625.

PROGRAMMED INSTRUCTION*

Mr. Donald J. Koza

District Manager

Behavioral Research Laboratories

Englewood, Colorado

What is programmed instruction? Programmed instruction is a teaching tool, just as blackboards, filmstrips, taperecorders, and movies are considered teaching tools. Like all teaching tools, however, one should be aware of both the advantages and the disadvantages, and how, when and where to use them. Programmed instruction is a flexible educational tool which is effective in transmitting factual information to a student at the individual student's own rate of learning. One should realize that programmed instruction is not a "cure-all," or something that is going to re-do the entire teaching process. It is merely a simple teaching tool.

An Overview of the Teacher's Role

The single most important factor bearing on the success of a programmed teaching situation is the teacher. The teacher working with programmed textbooks is even more important to the success of his class than is the teacher in the traditional lockstep setting. Research to date clearly shows that the dramatic results which are obtainable with programmed textbooks can best be achieved when the teacher understands the significance of his role.

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*Portions of this presentation were taken from Mr. Koza's presentation to the Workshop, while other sections are excerpts of a Behavioral Research Laboratories publication: "The How and Why of Effective Teaching With Programmed Instruction."

Working with programmed textbooks will bring about a notable change in the teacher's role in the classroom. One major change results from his being freed from the daily task of acting as a lecturer who continually supplies factual information to a group of students all moving at an identical pace. Although he continues to conduct lectures as he did in the past, lecturing is no longer his principal function. Instead, he has ample opportunity to work with each student in order to provide the individualized attention that is essential if the student is to realize his full potential.

Individualized instruction has long been viewed as a desirable objective; but how does the teacher manage to achieve such a goal in a real-life classroom situation? It is true that this objective is more readily achieved with programmed instruction; but what specific approaches can be used to help insure the realization of this goal? Here is where we are particularly fortunate in being able to draw upon the successful experiences of the many classroom teachers who have worked with programmed textbooks.

Before Class Begins

The teacher should first read through the program--carefully! He need not write the answers, but it is important that he go through the program in detail, just as his students will. By reading through the entire program before introducing it to the class, the teacher will be able to effectively schedule lectures, guest speakers, filmstrips, movies, and related material he wishes to present in conjunction with the program. Those teachers who have carefully read the programs with which they are working report that they gained a number of insights into the nature of programming technique--an understanding of the technique that they had not achieved from merely reading about programming.

The First Day

The first day in any class is always crucial insofar as it sets the tone for the entire year; but the first day in a class using programmed instruction will have even greater impact if the students have never encountered similar material. In such cases, the student faces not only a new teacher and a new subject, but a completely new classroom environment as well.

After the usual introduction to students, the teacher should tell them that they are being given the opportunity to use a new and more effective kind of textbook. It should be pointed out that the textbook is particularly effective because it is arranged in such a fashion that the subject is made readily understandable, and that each student will understand more and remember more because he will be able to learn at his own pace--neither pushed faster than he can comfortably work, nor held back if he happens to work rapidly. Students should know that as a result of this new approach the teacher will have more time to work with each of them individually.

General Approach

The experience of teachers and researchers clearly shows that an overwhelming majority of students strongly prefer programmed instruction to the traditional classroom situation. Nevertheless, a steady diet of programmed materials is not nearly so stimulating for the student as an approach that involves a variety of educational experiences. This situation is analogous to many that we all have experienced in our everyday lives. Suppose that you prefer steak to any other food. If we gave you steak morning, noon, and night, day after day, you would soon reach the point where your preference for steak would drop considerably. The use of programmed textbooks insures the opportunity to provide students with a variety of educational experiences. Teachers must be careful not to let student's initial preference for programmed materials override the importance of bringing them into contact with a number of different educational stimuli.

Structuring the Classroom for Programmed Instruction

Let's turn our attention to the various ways by which teachers have introduced variety into the classroom where our programmed textbooks are used.

An average school system schedules six or seven classroom periods daily; each is approximately 40 to 60 minutes in duration. These classes meet a specified number of days each week; and the teacher must cover a minimum amount of designated subject matter during a particular time period. To meet the requirements of this framework and still achieve the full benefits of the individualized instruction offered by programmed textbooks, most teachers suggest that a specific portion of the class time be set aside for work on the programmed textbook--the exact amount of time allotted depends on the intellectual level of the class and the material to be covered. Some teachers recommend a specific amount of time each class period, say 25 minutes; others suggest using the programmed textbook an entire period on specific days of each week. Both methods have their advocates and both work effectively. The determining factor in the choice is usually the length of the class period. In either method, the students must be told what specific portion of the material is to be covered prior to the examination.

For the purpose of illustration, let's assume that the following conditions exist. The class meets five periods a week for 50 minutes a period. On Mondays and Wednesdays, the first half of the period is spent with the students working on the programmed textbook. On Tuesdays and Thursdays, the students spend the second half of the period working on the program. On Friday, during the first half of the period, either a student/teacher discussion is held or a student panel is presented; the last half of the period is given over to an examination. Obviously, an examination will not always come on Friday. When an examination should be given will depend upon the amount of time you wish to spend on a particular section of the program. In the case of this illustration, however, we will assume you have decided to cover in five class periods the first section or chapter of the programmed material plus the examination of that section. Thus, the students begin on Monday morning by working through the first frames of the program. After half the period has elapsed, you stop the students. Even though they are somewhat spread out in their progress through the section, you conduct a general discussion of what they have read, at the same time questioning them to satisfy yourself that they understand the material thoroughly. On Tuesday, you begin with a lecture covering either the material that was presented in the program on Monday, the material that will be covered during the latter part of the period on Tuesday, or some pertinent material not in the textbook itself. On Wednesday, the students work on the program in the first half of the period with a filmstrip on a related topic. On Thursday, you devote the first half of the period to the programmed textbook. On Friday, you begin the period by holding a question and answer session and you end the period by giving an examination.

The experiences of teachers who have used an approach similar to this indicate that students who have shown a lack of motivation in the traditional lockstep classroom have responded enthusiastically. The atmosphere in the classroom using programmed textbooks in conjunction with lively class discussions and well-timed lectures has been extremely stimulating to both teacher and student and has produced a high degree of learning for students of varying capabilities.

Certain aspects of this plan need more thorough discussion. What do you do, for example, about the slow reader who has not completed the necessary material by examination time? If a student cannot read fast enough to cover the assigned material in time, and if he is forced to do so anyway, he will simply turn pages and later report that he has completed the assigned work. Therefore, we urge that under no circumstances should a student be assigned a minimum amount of material to be covered in class!

Let's explore this problem further. Note that in the traditional lockstep situation the student is obliged to follow the teacher's lecture. If the lecture moves too rapidly for him, he must raise his hand and ask that the teacher repeat or explain a point. If he asks a question, the rest of the class must sit idly by while the teacher answers. Most students stop asking questions quite early in their educational careers, particularly the slower ones who really need help. There is nothing more devastating to a student than to hear the mocking laughter of his classmates at a "stupid" question. Because the teacher in the traditional lockstop classroom must cover a prescribed amount of material in a specified time period, he has a difficult time giving individual attention to slower students. Even with the best intentions, the teacher in the traditional classroom must balance the needs of the slower students against those of the majority of the class since, if the class is halted to take time to deal with the slower students' questions, the rest of the class will be slighted. Yet any action on the part of a teacher that forces the student to go faster than he is capable of going causes severe educational problems. This "forcing" action probably is the foremost cause of failure in today's classrooms.

How does the classroom using programmed textbooks accommodate the needs of the slower student as well as the needs of his more capable colleagues? Note that under the plan described above the students are fully aware at the beginning of the week that an examination will take place at the end of the week. Moreover, they know precisely which frames will be covered in the weekly examination.

They also know that each class period will be divided into specific activities on a regular basis. Above all, however, the teacher will have made clear that in the event certain students do not complete the assigned material by the end of a period, in order to complete the assignments those students will be free to work on the programmed material at home or in study hall. This arrangement permits the slower student to move along at his own pace during class and yet maintain pace with the class at the beginning of each period. The responsibility of maintaining pace with the class belongs to the slower student, and he is provided a fair opportunity for doing so. Malingerers will appear in any classroom setting; and programmed instruction is no panacea. Bear in mind, however, that a number of students classified as malingerers are, in fact, simply students who cannot cope with the traditional classroom situation. Such students cannot maintain pace with the teacher's lectures and, as a consequence, lose ground steadily. Once behind the rest of the class, they are unable to catch up because the pace that forces them behind the rest of the class also denies them the extra attention they need in order to catch up. Given the means to solve this problem, a number of students classified as malingerers quickly demonstrate that such a classification is inaccurate.

Let's address our attention to the student who finishes his work well ahead of the rest of the class and who performs well on his examinations. Such a student should be praised for his accomplishment and should be encouraged to undertake extra credit enrichment work in the topic under study or perhaps in other topics. One of the most unfortunate aspects of the lockstep situation is that it keeps highly capable students marking time in order that the entire class may proceed in its work as a group.

Thus, the benefits of individualized instruction can be made available to both the slower and faster students in the classroom using programmed textbooks. It is worth noting in this regard, however, that the student who proceeds more rapidly at one stage of the presentation of the material than can the so-called "average" student, may, in fact, move more slowly at another stage.

Lectures

Because the teacher does not have to lecture every day, he can plan lectures in a manner that is not possible in the traditional classroom situation. The class using programmed textbooks will tend to look forward to the lectures because, in contrast to the traditional situation, the lectures can be used to amplify and enrich the subject matter presented by the programmed textbook. The teacher can make the material timely by relating it to current events, and topical by showing how it applies to a specific local situation. The teacher should not overlook the opportunity to use relevant audio-visual materials wherever they might be appropriate.

Since the student will be securing his basic information from the programmed textbook, much of the time otherwise given over to lecture and drill can now be allotted to structuring classroom discussions in which the students are given the chance to rephrase concepts and to articulate them in their own words. Such opportunities for discussion should be provided at *regular* and *frequent* intervals throughout the course.

Summing Up

In brief outline fashion let us sum up, then, the steps that we suggest that should be followed in using programmed textbooks in the usual school system situation:

1. Go through the program carefully before the first day of class. Select topics for future lectures. Plan filmstrips, motion pictures, guest lecturers, etc.

2. Use the first day to explain the format and how programmed instruction works.

3. Set up a schedule whereby students work with the programmed textbooks during only a portion of their classroom time.

4. Set minimum standards so that all students are expected to cover at least a certain portion of the material by the day of the examination. Let them know when examinations will be given and what sections the examination will cover.

5. Do not force the slow student to cover the required amount of material in class. Do give him an opportunity to keep up with the class by taking the material home or to study halls. Do not hold the fast student back.

6. In working with the individual student, make sure that even the less able ones receive a great deal of praise and encouragement.

7. Always grade your examinations as soon as possible. Be sure that you give the results to the students at the earliest opportunity. Use the examinations diagnostically and discuss them with those students who are having difficulties.

8. When you find that a student is having difficulty, take the necessary steps to help him before allowing him to proceed.

9. Try to include current topics and specific local material in your lectures.

10. Allow plenty of time for student participation. Try to see that all students actually do participate.

The research, both government-sponsored and private, clearly indicates that teachers and students who are in a classroom using programmed instruction overwhelmingly prefer it to the traditional classroom. This new kind of educational experience is one of the fastest growing innovations in education; and its emphasis on individualized instruction--along with other developments such as flexible scheduling, ungraded schools, and the like--indicates that the classroom teacher is leading the way in breaking out of the restrictive bonds of the conventional lockstep process.

WYOMING INDUSTRY BY COUNTY: 1967*

The following list has been included in this publication as an aid to future researchers who desire to contact various industries within the State of Wyoming. The list was reprinted from a publication entitled: "Industrial Capability Register 1967." The original publication was sponsored by the Colorado Interstate Gas Company, Colorado Springs, Colorado, with the cooperation of the Wyoming Natural Resource Board and the Business Development Division of the Casper Chamber of Commerce.

The original document contains Wyoming industrial listings according to: (1) county, (2) industry by classification, and (3) alphabetization, and may be obtained from the Wyoming Research Coordinating Unit, Cheyenne, Wyoming.

Standard Industrial Classification

The Standard Industrial Classification was developed for use in the categorizing of establishments by type of activity in which engaged; for purposes of facilitating the collection, tabulation, presentation, and analysis of data relating to establishments; and for promoting uniformity and comparability in the presentation of statistical data collected by various agencies of the U. S. Government, state agencies, trade associations, and private research organizations.

Although the SIC numerical codes are constructed to cover the entire spectrum of economic activities, only the following manufacturing categories are included in this list:

Group	1000	Concentration and similar plants
	1200	Coal Mining
	1300	Crude Petroleum and Natural Gas
	1400	Non-Metallic Minerals

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*Compliments of the Colorado Interstate Gas Company, Colorado Springs, Colorado; the Wyoming Natural Resource Board; and the Business Development Division of the Casper Chamber of Commerce.

Group 2000	Food and Kindred Products
2300	Miscellaneous Fabricated Textile Products
2400	Lumber and Wood Products
2500	Furniture and Fixtures
2800	Chemicals and Allied Products
2900	Petroleum Refining
3000	Rubber and Miscellaneous Plastics
3200	Stone, Clay and Glass Products
3300	Primary Metals Industry
3400	Fabricated Metal Products
3500	Machinery, except Electrical
3600	Electrical Machinery and Equipment
3700	Transportation Equipment
3800	Professional, Scientific and Controlling Instruments
3900	Miscellaneous Manufacturing

For reference purposes, the SIC number of each company, together with its name, address, and city has been included in the following list.

SIC	Name	Address	City
		ALBANY	
3444	A & R Metal Products	413 Fetterman	Laramie
3273	C & M Ready Mix Concrete Co.	119 Baker	Laramie
2421	Creike Lumber Co.		Centennial
2431	Deines Cabinet & Millwork	North of Town	Laramie
2491	Forest Products Treating Co.	P.O. Box 910	Laramie
3079	Howard Roberts	University of Wyoming	Laramie
3444	Laramie Heating & Sheet Metal	1004 So. 2nd	Laramie
3591	Logan's Machine & Supply, Inc.	470 N. 3rd	Laramie
2431	Lutz Cabinet Co.	P.O. Box 372	Laramie
2033	McConnel Brothers	1356 N. 2nd	Laramie
3613	Medical Engineering Assoc.	118 Grand Ave.	Laramie
3241	Monolith Portland Midwest C.	P.O. Box 40	Laramie
3444	Morgans Heating & Sheet Metal	358 N. 3rd	Laramie
2421	North Park Timber Co.		Laramie
2421	Otto Lumber Co.	P.O. Box 670	Laramie
3591	Snow Welding Service	460 Garfield (West)	Laramie
3271	W. & W. Concrete Products	Rt. 1, P.O. Box 672	Laramie
3271	Western Concrete Prods. Co.	P.O. Box 171	Laramie
3273	Wyoming Construction Co.	P.O. Box 907	Laramie
3273	Yeoman Const. Co.	P. O. Box 880	Laramie
		BIG HORN	
1452	American Colloid Co.	Northeast of Town	Lovell
2033	Big Horn Canning Co.		Cowley
2491	Cowboy Timber Treating, Inc.	P.O. Box 78	Manderson

SIC	Name	Address	City
2063	Great Western Sugar Co.	400 Great Western Ave.	Lovell
3275	Gypsum Products of America	Southeast of Town	Lovell
3259	Lovell Clay Products Co.	P.O. Box 247	Lovell
3273	Nicholls & Lewis Ready Mix		Lovell
2911	Sage Creek Refining Co.	P.O. Box 179	Cowley
3499	Sim's Stoves	771 Montana	Lovell
3714	Stockwell Manufacturing Co.		Greybull
	CAMPBELL		
3591	L. & H. Welding & Machine	P.O. Box 1820	Gillette
3591	Leon's Repair Service	911 Douglas Highway	Gillette
3273	Reeves Concrete Products	P.O. Box 825	Gillette
1211	Wyodale Resources Dev.	P.O. Box 149	Gillette
	CARBON		
1321	Colorado Interstate Gas Co.	P.O. Box 370	Sinclair
2321	Hammer Lumber & Timber Prods.		Encampment
3271	McNiff Cinder Block Co.	9th and Railroad	Rawlins
3273	Miller Redi-Mix, Inc.	East of City	Rawlins
2892	Monsanto Co.	Southeast of City	Rawlins
2431	Pioneer Mill & Const. Co.	P.O. Box 388	Rawlins
3443	Poling Iron Works	P.O. Box 811	Rawlins
2421	R. R. Row & Co.		Saratoga
2911	Sinclair Refining Co.		Sinclair
3444	Triangle Sheet Metal	306 E. Cedar	Rawlins
1321	UPR, Nat. Resource Dev.	400 W. Front	Rawlins
	CONVERSE		
2879	American Humates, Inc.	East of Town	Glenrock
3273	Eagle Transit Mix		Douglas
2421	Fawcett Sawmill	South of Town	Douglas
3591	M. C. Repair Shop	244 N. 2nd	Douglas
2421	Russell Lumber Co.		Douglas
	CROOK		
2421	Johnson Sawmill		Hulett
2421	Neiman Sawmill		Hulett
2421	Nicholsen Tower Sawmill		Sundance
	FREMONT		
3444	ACB Tin Shop	111 N. 1st	Riverton
3444	AL Robinson, Inc.	640 N. 4th St.	Lander
1321	Atlantic Refining Co.	East of City	Riverton

SIC	Name	Address	City
3444	Custom Sheet Metal	153 N. 4th	Lander
3591	Dick's Welding Service	262 Washakie	Lander
2491	Empire Timber Treating Co.	P.O. Box 353	Riverton
1094	Federal Gas Hills Partners	520 E. Main	Riverton
3271	Gen Dandy Concrete Specialties	Highway 789 South	Hudson
2892	Hercules Powder Co.	P.O. Box 607	Lander
3444	Ideal Sheet Metal Co.	1405 N. Highway	Riverton
3591	Kier Welding & Machine	149 Main St.	Lander
3273	Lander Ready Mix	Mortimer Lane	Lander
1321	Pan American Petroleum Corp.	P.O. Box 1400	Riverton
3272	Riverton Concrete Products	North of City	Riverton
3591	Riverton Machine Co.	S. Federal & Monroe	Riverton
3444	Riverton Sheet Metal Works		Riverton
2542	Sherart, Inc.	Riverview Route	Riverton
3591	Superior Bit Service	524 So. Federal Blvd.	Riverton
3449	Superior Bit Service	531½ So. Federal	Riverton
2819	Susquehanna-Western, Inc.	Southwest of Town	Riverton
2421	Teton Studs, Inc.	P.O. Box 6783	Riverton
2421	Teton Studs, Inc.	P.O. Box 475	Dubois
1094	Union Carbide	P.O. Box 5100	Gas Hills
1011	U.S. Steel Corp.	P.O. Box 569	Lander
1094	Utah Construction Lucky McMine	Box 831	Riverton
1094	Western Nuclear		Jeffrey City
3273	Wind River Ready Mix	South Riverton	Riverton
3571	Wyoming Electrodata Corp.	309 E. Main St.	Riverton
2841	Wyoming Janitorial Supply	120 So. Second	Riverton
	GOSHEN		
3272	Goshen Irrigation District		Torrington
2063	Holly Sugar Corp.	South of Town	Torrington
3271	Torrington Cement Products	P.O. Box 392	Torrington
2022	Wyoming Dairy Foods	1839 E. A St.	Torrington
	HOT SPRINGS		
3273	Big Horn Redi-Mix	6th & Shoshone	Thermopolis
2911	Empire State Oil Co.	242 Amoretti St.	Thermopolis
3273	Rollins Gravel & Ready Mix	S.E. Amoretti	Thermopolis
3591	SRS Machine & Supply Co.	5th & Richards	Thermopolis
	JOHNSON		
2421	Andy Hanson Sawmill	87 W. Brook	Buffalo
2099	Beemaid Honey	574 Fort St.	Buffalo
3391	Buffalo Forge & Welding	School St.	Buffalo
3273	J & S Ready Mix	P.O. Box 81	Buffalo
2421	Johnson Sawmill	Western Ave.	Buffalo
3591	Mikes Welding Shop	135 So. Pine	Buffalo

SIC	Name	Address	City
3591	Northern Machine Works	44 North Carrington	Buffalo
2421	Pierson Wood Products Co.	21 Sunset Ave.	Buffalo
3273	Reeves Concrete Products	P.O. Box 389	Buffalo

LARAMIE

3271	Benham Precast	1111 East 8th	Cheyenne
2421	Brandt Wicklund Lumber Co.		Fox Park
3591	Brenning Machine Shop	611 W. 21st	Cheyenne
2431	Cheyenne Sash & Door Service	821 W. 10th St.	Cheyenne
3444	Cheyenne Sheet Metal	P.O. Box 2347	Cheyenne
2394	Cheyenne Tent & Awning	509 W. 17th St.	Cheyenne
3273	Cook, McCann Concrete, Inc.	819 East 15th	Cheyenne
3611	Dynalectron Corp.	P.O. Box 2327	Cheyenne
3611	Empire Engineering	1712 Pioneer	Cheyenne
2911	Frontier Refining Co.	P.O. Box 418	Cheyenne
3821	Ideal Aerosmith	3913 Evans	Cheyenne
3272	International Pipe & Ceramics Co.	P.O. Box 89	Cheyenne
3273	John Morandin & Son	1201 W. 22nd	Cheyenne
3444	Kinman Sheet Metal	1123 E. Lincoln Way	Cheyenne
3442	Kool Vent Awning Co.	2301 E. 9th	Cheyenne
3444	Kreuzer Sheet Metal	304 W. 15th	Cheyenne
3444	L K Fabricating	2703 E. 8th	Cheyenne
3811	Master Equipment Co.	3913 Evans	Cheyenne
3271	Powers Brick & Tile Co.	1003 E. Lincoln Way	Cheyenne
3273	Read Ready Mix Co.	E. Fox Farm Rd.	Cheyenne
3444	Sheet Metal Products	1019 W. 22nd	Cheyenne
3441	Tri-State Steel Co.	P.O. Box 305	Cheyenne
3444	Western Sheet Metal	1015 East 14th	Cheyenne
3079	Western Specialties Mfg. Corp.	P.O. Box 2192	Cheyenne
2819	Wycon Chemical Co.	P.O. Box 1251	Cheyenne
3411	Wyott Corp.	720 W. 18th St.	Cheyenne

LINCOLN

3591	Coletti Welding Shop	405 Ruby	Kemmerer
1321	El Paso Natural Gas Co.	Gasoline Plant	Opal
3273	Fairview Ready Mix	1429 West Ave.	Kemmerer
3312	FMC Corp.	P.O. Box 431	Kemmerer
3591	General Machine Works	Coral & Sage	Kemmerer
2421	Greys River Lumber Co.		Alpine Jct.
1211	Gunn Quealy Coal Co.		Frontier
3721	IMCO, Inc.	P.O. Box 547	Afton
1211	Kemmerer Coal Co.		Frontier
3591	O. H. Kampman & Sons	Box 193	Diamondville
2819	San Francisco Chemical Co.	P.O. Box 160	Montpelier, Ida.
2421	Star Valley Lumber Co.	P.O. Box 517	Afton
2022	Star Valley Swiss Cheese Co.		Thayne

SIC	Name	Address	City
		NATRONA	
3591	Acme Tool, Inc.	P.O. Box 106	Casper
3799	Aetna Trailer Sales	P.O. Box 333	Casper
2911	American Oil Co.	P.O. Box 160	Casper
1452	Black Hills Bentonite Co.	Box I	Mills
1452	Benton Clay Co.	Box 432	Casper
3441	Black, Sivalls & Bryson, Inc.	P.O. Drawer 319	Casper
3273	Casper Concrete Co.	1525 East F. St.	Casper
3591	Casper Grinding & Supply	P.O. Box 2385	Casper
3471	Casper Plating & Mfg.	1149 East Yellowstone	Casper
3444	Caster Tin-Natrona Roofing	808 East A	Casper
2431	Cole Custom Cabinets	700 East C	Casper
3444	Culverts & Industrial Supply	P.O. Box E	Mills
3481	Electriduct Co.	P.O. Box 2406	Casper
2431	Farrar Cabinet Co.	1229 E. 3rd	Casper
3444	Glendale Heating	110 Oregon Trail	Casper
3312	Great Lakes Carbon Corp.	P.O. Box 2072	Casper
3272	International Pipe & Ceramics	P.O. Box 291	Casper
3591	Jim's Welding Service	120 West H. St.	Casper
2851	Jourgensen Paint Mfg. Co.	242 W. Yellowstone	Casper
1321	Kansas Nebraska Nat. Gas, Inc.	P.O. Box 55	Casper
2394	Kistler Tent & Awning Co.	424 So. Oak	Casper
3591	K-D Casting Service Co.	P.O. Box 1267	Casper
2431	Millwork, Inc.	241 W. 1st	Casper
2911	Mobil Oil Co.	P.O. Box 240	Casper
3273	Mobile Concrete Co.	P.O. Box 1129	Casper
3444	Pancratz Co.	1220 E. Yellowstone	Casper
1094	Petrotomics Co.	P.O. Drawer 2450	Casper
3441	Pittsburg Des Moines Steel Co.	1657 East Yellowstone	Casper
3591	Precision Machine Shop	201 So. 3rd Ave.	Casper
3723	Rafferty Mill & Fixture Co.	228 Nichols	Casper
3444	Rocky Mtn. Sheet Metal	228 N. Nichols	Casper
3441	Rocky Mtn. Tank & Steel Co.	3200 West 13th St.	Casper
1321	Sinclair Oil & Gas Co.		Bariol
2911	Texaco, Inc.	P.O. Box 320	Casper
3271	Thurston Block Plant	1207 North Grant	Casper
2813	Union Carbide Corp.	648 Bryan Stock Trail	Casper
2431	Western Cabinet Shop	815 Winbourne	Casper
3591	Western Oil Tool & Mfg., Inc.	P.O. Box 260	Casper
3591	Western Service & Supply	307 South Durbin	Casper
3591	Wortham Machinery Co.	1805 E. F St.	Casper
		NIOBRARA	
2911	C & H Refinery	Southwest of Town	Lusk
3273	Frontier Lumber Co.	P.O. Box 1058	Lusk
3481	Western Repair Shop	P.O. Box 242	Lusk

SIC	Name	Address	City

PARK

3591	B & B Welding & Machine	Route 1	Cody
3275	Big Horn Gypsum Co.	P.O. Box 599	Cody
3591	Bormuth Welding & Machine	713 N. 16th St.	Cody
2421	Cody Lumber, Inc.	P.O. Box 752	Cody
3591	Cody Welding & Machine	1231 13th St.	Cody
3591	Dawson Machine & Welding	143 South Bent	Powell
3273	Feeley Bros. Ready Mix	North of Town	Cody
2911	Husky Oil Co.	P.O. Box 380	Cody
1321	Pan American Petroleum Corp.	P.O. Box 569	Powell
1321	Ralston Processing Assoc.	P.O. Box 958	Powell
3591	Superior Machine Co.	P.O. Box 792	Powell

PLATTE

1011	CF&I Steel Corp.	Sunrise Mine	Sunrise
3591	Drube's Machine Shop	Box 29	Wheatland
3591	Glen's Blacksmith	1555 Spruce	Wheatland
3591	Ranch Hand Products		Wheatland
3273	Wilson Bros., Inc.	206 12th St.	Wheatland

SHERIDAN

1211	Big Horn Coal Co.	North of Town	Sheridan
3273	Custom Concrete Products	P.O. Box 610	Sheridan
3444	Frickeys Sheet Metal Works	545 North Main	Sheridan
3591	Jensens Machine Works	43 Brundage Pl.	Sheridan
3273	Mullinax Concrete Serv.	P.O. Box 817	Sheridan
3679	National Coil Co.	P.O. Box 1347	Sheridan
3444	Prill Bros.	40 East 5th	Sheridan
3251	Sheridan Brick & Tile Co.	711 Carrington	Sheridan
2045	Sheridan Flouring Mills	P.O. Box 921	Sheridan
3591	Sheridan Iron Works, Inc.	P.O. Box 747	Sheridan
2394	Sheridan Tent & Awning	128 N. Brooks	Sheridan
2431	Specialty Woodcraft	226 N. Brooks	Sheridan
3949	Spin-A-Line Mfg. Co.	130 W. Montana	Sheridan
3591	Western Steel & Machine Works	401 Broadway	Sheridan
2421	Wyoming Sawmills, Inc.	P.O. Box 1244	Sheridan
3591	York's Shop	152 E. Montana	Sheridan

SUBLETTE

1474	Allied Chemical Co.	West of City	Green River
3443	American Tank & Steel Corp.	West of City	Rock Springs
1474	Church & Dwight Co.		Green River
3273	De Bernardi Bros.	223 Angle	Rock Springs
1474	FMC Corp.		Green River
3273	Hillside Concrete	507 Smith Street	Rock Springs

SIC	Name	Address	City
3273	Rahonce Concrete Co.	317 Smith	Rock Springs
3444	Rich Heating & Sheet Metal	115 Blair	Rock Springs
3591	Rock Springs Machine Shop	724 Gobel	Rock Springs
1474	Stauffer Chemical Co.	Northwest of City	Green River
3591	T. L. Roberts Welding Service	525 Dewar Dr.	Rock Springs
2892	Universal Supply Service, Inc.	625 B	Rock Springs
3591	Wallace Machine Shop	218 R	Rock Springs
3444	White Sheet Metal Works	1025 Elk	Rock Springs
3271	Wyoming Masonry Products	P.O. Box 727	Rock Springs
3444	Wyoming Sheet Metal Works	144 K St.	Rock Springs

TETON

SIC	Name	Address	City
3273	Clark's Ready Mix	P.O. Box 474	Jackson
3451	Teton Machine Co.	Box 1019	Jackson
3499	Wedco Mfg. Co.	50 North St.	Jackson

UINTA

SIC	Name	Address	City
3273	Ellingford Bros., Inc.	201 County Rd.	Evanston
3591	Fife Welding & Machine Co.	86 Second Ave.	Evanston
2421	Price Valley Lumber Co.	Front St.	Evanston
2421	South & Jones Timber Co.		Evanston
2431	Wyoming Industries, Inc.	Northwest of Town	Evanston

WASHAKIE

SIC	Name	Address	City
2421	Cold Springs Lumber Co.	P.O. Box 126	Worland
3591	Harres Welding Service	P.O. Box 25	Worland
2063	Holly Sugar Corp.	P.O. Box 268	Worland
3591	P & S Machine, Inc.	P.O. Box 477	Worland
1321	Pure Oil Co.	Northern Prod. Unit	Worland
3591	Quality Welding & Machine, Inc.	919 Railroad Ave.	Worland
3273	Sorenson Ready Mix & Block Co.	North of City	Worland
2819	Texas Gulf Sulphur	North of Town	Worland
3821	Western Industrial Co.	P.O. Box 610	Worland

WESTON

SIC	Name	Address	City
1452	ADM Chemicals		Upton
1452	ADM Chemicals		Colony
1452	American Colloid Co.		Upton
1452	Baroid Div.	National Lead Co.	Osage
1452	Baroid Div.	National Lead Co.	Colony
2421	Berman Lumber Co.	P.O. Box 490	Newcastle
3273	Black Hills Ready Mix	540½ Main	Newcastle
3591	Lloyd McIntosh Machine Co.	434 Pine	Newcastle
2911	Sioux Oil Co.	P.O. Box 820	Newcastle
2045	Toomey's Mills	500 W. Main	Newcastle